University of Alberta

Indigenous Knowledge and Languages in the Teaching and Learning of Science: A Focus on a Rural Primary School in Zimbabwe

by

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DEDICATION

This work is dedicated to my family; Sebia (my wife), my children; Anesu Evans, Rufaro Samantha and Ruvimbo Sandra whose inspiration, patience and perseverance through the hard times during my long periods away from home gave me the push to succeed and soldier on. To my mum, brother and sister, and the whole extended family, including my in-laws, I salute you all for the support you gave my "deserted" family and me.

ABSTRACT

Teachers are known for their "gate-keeping" roles in schools, especially in the classroom setting. They process and decide what "knowledge" is "valid" and "appropriate" for students. They also decide when and how the knowledge should be mediated to students. Their gate-keeping role marginalizes some forms of knowledge while validating and legitimating others. This qualitative and constructivist-interpretive case study is an exploration and description of ten rural primary school teachers' experiences in teaching science using indigenous perspectives in Zimbabwe. The purpose of the study was to discover and describe, using qualitative inquiry, how teachers incorporate indigenous knowledge and languages in teaching science in a rural primary school in Zimbabwe. The study also sought to understand teachers' mediation techniques in the process of bridging the cultural gap between formal science and indigenous knowledge that students bring into the classroom from home.

In this study, I elicited, from teachers, their understanding of the interconnectedness of indigenous knowledge and Western science. I employed qualitative inquiry to collect data from them in their natural working environment, the school and the classroom. Purposive sampling was utilized to select ten teachers who were observed teaching two science lessons each. All the lessons were captured using a video recorder, which facilitated the collection of as much information as possible from events occurring in the classroom. Later, semi-structured interviews/conversations were audio-recorded from the same teachers to elicit their insights and experiences in teaching science using indigenous perspectives and languages. Policy documents and science syllabuses were also perused for information on what teachers were expected to teach in science. Inductive analysis was employed to interpret findings that resulted in thick and in-depth narratives. The findings from these narratives revealed differences and similarities in teachers' views and experiences, and their fears and concerns in using indigenous knowledge and languages to teach science in Zimbabwe. The conclusions derived from these findings, though specific to the teachers in this study, gave rise to policy and pedagogical recommendations for increasing the use of indigenous knowledge and languages in the science curriculum in Zimbabwe.

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CHAPTER I

INTRODUCTION

Background to the study

The discourse on knowledge, especially in postcolonial Africa, is a contentious and contested field. Postcolonial theory or discourse is anti-colonial and uses open-ended language to describe colonial education systems and how they imposed definitions of knowledge on indigenous people in Africa. The formal school and the curriculum that define what counts as "knowledge," today, are a legacy of colonial rule. The school curriculum tends to ignore or not to adequately respect or acknowledge the present contradictions between children's private and public lives. The knowledge that children bring to school is personally, socially and culturally constructed. However, in contradiction to children's beliefs and worldviews, the school's curriculum presents knowledge as objective as well as politically, technically or rationally constructed. Often policy makers and school administrators ignore or suppress children's cultural differences in their quest to measure children's mastery of specific content and to socialize them for the world of work. Thus, education policy and school curriculum often bear little or no resemblance to children' real cultures. It is not clear, in the case of Zimbabwe, the extent to which school curriculum acknowledges and respects the great variety of alternative views that children from different social and cultural backgrounds bring to school.

Schooling should bear some relation to the child's background, if it is to provide meaningful and rewarding learning experiences. Many aspects of the students' childhood, socialization and culture should have direct impact on and implications for the philosophy of schooling, curriculum, and pedagogical practices. If the content and process of schooling respected varying, competing subcultures, it would better support local communities of people and help restore their pride in their culture. According to Bruckerhoff (1995, p.390),

> Children's families vary greatly, but they can be placed along a spectrum running

> from advantaged to disadvantaged. Children in advantaged families have values that supersede the school curriculum, and other members who benefited from school. Advantaged children come from many different races, ethnic groups, and religions, but they usually live above the poverty level. Disadvantaged children often come from families whose values are rooted in folk cultures rather than dominant high status cultures. Their values usually either clash with the public school curriculum or do not engage with it at all.

Unfortunately for disadvantaged children in Zimbabwe, most of whom live in rural areas, the school discriminates against their cultures and instead promotes the dominant high status culture of the advantaged children who are largely found in urban areas. The contestability and/or incontestability of various versions of socio-cultural reality that form the bedrock of knowledge creation is an issue that is central to sociological debate.

Schooling in Zimbabwe is largely a legacy of British colonial hegemony. It is an elitist legacy that promotes a particular worldview of knowledge. The hegemonic colonial worldview ignores other multiple realities of social and cultural life that exist in the country. The colonial knowledge constructs that were imported from England are deeply embedded in school curricula and continue to be reproduced by the education system in Zimbabwe. The hegemonic school curricula are moreover, an instrument of power that serves to perpetuate a knowledge imbalance already inherent in post-colonial society. Leach, Neutze and Zepke (2001, p.294) point out that "hegemony occurs when an already dominant social group, like educational and other professionals, establishes the authority of its ideas and processes with other groups and thereby gains popular acceptance, even support." For example, the prevailing hegemony in education in Zimbabwe holds that there are bodies of knowledge that are universally true, invests power in the teacher, and inculcates in and entrenches a faith in the scientific notions of objectivity, validity and reliability. Accordingly, this hegemony negates views that emphasize difference and diversity, and the notion that knowledge is subjectively and socially constructed. The schooling system inherited from former colonial powers therefore marginalizes the local people's worldview and everyday life experiences. What is defined as knowledge is embedded in the Euro-centric or Anglo-Saxon scientific socio-cultural reality and worldview. Giroux (1992) argues that postcolonial education rewrites the relationship between the margins and the center by reproducing the colonialist and imperialist ideologies that structure Western knowledge, text and practices. This is so because schooling and knowledge in Africa are defined for Africans from the perspective of outsiders who disregard the social and cultural realities of the local people.

Johnson (1990) observes that despite great strides in quantitative improvement in access to formal education in the 1980s, schooling in Zimbabwe remains locked into a pre-independence mode. In the classroom, the colonially defined power differential between the teacher and the student persists and remains largely intact. Teachers continue to depend on their authority and strict discipline to put across a narrowly defined and largely alien worldview. Teacher practices have remained embedded in the British view of reality, which largely contradicts both teachers' and students' personal, social and cultural realities. The net effect for both teaching and learning is cultural alienation. Teachers and students, alike, struggle to make sense of and construct meaning from the curricula and knowledge that is imposed on them. Schooling overall, and the prevailing teaching and learning styles, thus alienate both teachers and students from the process of knowledge acquisition. According to Jegede (2000), Western knowledge, and science in particular, is used to further oppress students who are from non-Western indigenous backgrounds. The alienation of students engendered by Western science can cause cultural alienation and symbolic violence, the unintentional devaluing of a learner's cultural beliefs and values (Bourdieu, 1973; Tobin, 1996). Cultural alienation occurs when schooling seeks to replace traditional, indigenous culture instead of blending with it or building upon it. Johnson (1990), for example, argues that the teacher in Zimbabwe is "just another brick in the wall" that serves to encourage passivity and social conformity rather than create spaces and voices for students.

In present-day Zimbabwe, students need more locally constructed and applicable knowledge that mirrors their social and cultural consciousness rather than exclusively externally defined and alienating knowledge. They need empowerment through knowledge that is relevant to their social and cultural realities: knowledge that they can easily identify with and can make use of to develop themselves and their communities. The teacher in Zimbabwe, thus, should play a vital role in making students cross smoothly the barriers that separate Western science from indigenous knowledge. Aitkenhead and Jegede (1999) suggest that cultural border crossing involves flexibility, playfulness, and a feeling of ease, all matters of the heart. But this form of teaching and learning cannot take place as long as Western science is mystified and indigenous knowledge/science is mythicized. If science teachers in particular devalue indigenous ways of constructing, recording and transmitting scientific knowledge and understandings, they not only alienate most indigenous students from science education, but also deny for themselves perspectives that have potential to enrich their own scientific understanding. Schools that are in contact with indigenous communities thus should take positive steps to make science more culturally inclusive and relevant.

Against this backdrop of a Euro-centric perspective on scientific knowledge, the Government of Zimbabwe is aware of the historical framework in which science and school knowledge in general is situated. Machinga (2000) points out that the post-independence Education Act of 1987 was designed to create a new democratic society within which an egalitarian education system would serve the educational needs of all communities and ethnic groups and extend the right to education to all children.

The Presidential Commission of Enquiry into Education and Training of 1998 states that one of the goals of education in Zimbabwe should be to promote local cultural values and norms through the teaching and learning of appropriate humanities and indigenous knowledge (Government of Zimbabwe, 1998). Although the government seems to appreciate the need for learning to be culturally relevant, it is silent on how this should be put into practice. However, Machinga (2000) and Chombo (2000) note that among the major challenges for schooling in Zimbabwe is the need to design a holistic education, guided by indigenous philosophy that promotes cultural values. Chombo (2000) also argues that education in Zimbabwe should shift from the prevalent and pervasive influence of foreign cultures and needs measures to strengthen the bases of local knowledge. Makhurane (2000) concurs with Chombo and Machinga and observes that one of the challenges facing schooling in Zimbabwe is to undertake a change in orientation in order to achieve culturally appropriate science and technologies and increase the participation of previously disadvantaged social groups in science and technology. These are the challenges that teachers face in their everyday lives in the classroom as they teach students who battle with the alien scientific worldview portrayed in the current science curriculum.

The problem statement

This study is an investigation/exploration of the teaching experiences of ten teachers in a rural primary school in Zimbabwe as they attempt to incorporate or integrate indigenous knowledge and languages in teaching formal science. For more than 20 years as an educator in Zimbabwe I have observed that the teaching and learning of science is predominantly at the level of abstraction. As such, it is very remote from the knowledge students bring from their homes and communities. Teaching is, therefore, largely a passive process whereby teachers extract information from textbooks and pass this information on to students as unchallenged "facts" and "knowledge." Such an approach to teaching science, defined from Western perspectives, leads students to fail to recognize science as knowledge that is lived experience and part of their indigenous worldview. Rather, science is perceived as knowledge that lies outside the social and cultural realities of the rural student. In the process of knowledge construction and mediation, moreover, indigenous knowledge is sidelined and marginalized from the curriculum and classroom interactive activities.

The purpose of the study

The need to ensure that schooling, in general and the science curriculum in particular, recognize and value the social and cultural milieu in which the majority of children in Zimbabwe are socialized cannot be overemphasized. To disregard the socio-cultural environment of learners would be to further hinder students' ability to either benefit from schooling or to develop positive cultural identities. There exists a wide gap between the culture of formal education and that of the majority of students as well as their teachers. This disjuncture is a major contributor to teaching and learning difficulties and to unsustainable development in rural communities where most indigenous Zimbabweans live. Indigenous cultural values, knowledge and science are not only trivialized and devalued, but dislocated from official science curricular and socio-economic development.

The purpose of this interpretive case study was, therefore, to discover and describe how teachers incorporate indigenous knowledge and languages in the teaching of science in a rural primary school in Zimbabwe. The study also sought to ascertain teachers' experiences and the mediation techniques they employed to bridge the cultural gap between formal science and the knowledge that their students brought from their homes and communities to the classroom. For the purpose of this study indigenous knowledge is defined as " the local knowledge that is unique to a given culture or society" (Warren, 1991, p.6). It is the knowledge that is embedded in the community and is unique to a given culture, location or society. The term indigenous knowledge, in other words, refers to the large body of knowledge and skills that have been developed to enable communities to survive.

Rationale

This research project evolved from my concern with the questionable documented quality, lack of depth, and narrow focus that typifies the teaching of science in primary schools in Zimbabwe (Shumba, 1999; Machinga, 2000). I have always been interested in finding ways through which indigenous knowledge and languages could be integrated into the science program in primary schools in Zimbabwe. Not many students continue in science subjects in post-primary education, and of those who do so, only a few of them pass these subjects. Too many students in Zimbabwe, particularly girls, are dropping science at secondary school as soon as they can (Gwaunza & Nzira, 1997). It is acknowledged that there are many complex factors that force students to drop science subjects or to underachieve. Among a plethora of reasons is the negative attitude many students have toward science (Gwaunza & Nzira, 1997). This may be a result of how science is taught in the primary grades, which prepare students for secondary schooling.

Many academics feel that school science in Zimbabwe marginalizes the world experiences that students have outside the school (See, for example, Gwaunza & Nzira, 1997; Shumba, 1999). The negative messages transmitted by schools about students' home culture are a major hindrance to students' performance and achievement in the subject. The teaching strategies employed in science, moreover, appear to cause students to withdraw from involvement in learning. But a unilogical, assimilative discourse that transmits Euro-centric scientific knowledge and values to students in primary schools in Zimbabwe is even of greater concern. One view of scientific knowledge predominates in the school curriculum, textbooks and teachers, and that worldview promotes and reinforces the hegemonic practices of the colonial education system.

Students' underachievement in science has been attributed to "cultural gaps" between the expectations of the school curriculum and those of the cultures into which students are socialized (Thaman, 2001). In Zimbabwe, this gap not only exists among students, but also among the majority of teachers. Shumba (1999) observes that in times of crisis the majority of Zimbabweans, including the educated, hold to, or at least fall back on, beliefs and practices they acquire from their indigenous African culture. Although adherence to one's culture is not a bad thing, in this case a wide gap exists between indigenous Zimbabwean cultural beliefs and the scientific worldview Western education seeks to foster. Therefore, this study sought to determine teachers' experiences in their quest to close this gap in relation to the teaching of science in primary schools in Zimbabwe. Furthermore, the current euphoria for an education system that responds to the demands of economic forces also makes issues such as cross-cultural transfer, globalized curricula and appropriate learning strategies worthy of urgent critical consideration. The urgency arises from the fact that globalization is blurring cultural diversity and educational services are becoming increasingly standardized and homogenized.

UNICEF (1994), reporting on Zimbabwe's education system after independence, states that great strides were made in the 1980s in terms of revising the curricula to include more African and context-sensitive material as part of the effort to re-direct Zimbabwean education away from the academic and Euro-centric orientation of education under colonial rule. One issue to be examined in this study is the extent to which the curriculum includes the incorporation of cultural relevance in science. To provide a more African context to the curriculum requires more than just changing instructional material; also needed is a reorientation and retraining of teachers so that they are capable of employing science teaching strategies that constitute what O'Loughlin (1992, p.816) describes as "dialogical meaning making." In a safe and caring classroom environment that welcomes students' cultural experiences, learners need to be given more space to play an active role in developing a personally constructed understanding of what science means in terms of their everyday lived experiences. Teachers, as facilitators of students' learning experiences, should develop and employ pedagogical approaches that help students move from their cultural life-worlds into the world of school science.

Significance

Since it is widely agreed that indigenous worldviews are largely absent from Zimbabwe's science curriculum, it is hoped that the insight obtained from this study will help transform the teaching of science in that country's primary schools. The information generated might help teachers to revisit their teaching strategies and adopt approaches that would in turn help students to cross cultural borders and surmount barriers that stand between indigenous knowledge and Western science. New approaches to the teaching of science that incorporate the local knowledge of the community and the home culture of the students are likely to facilitate border crossing into the culture of Western science. Border crossing could be made smoother for students and teachers alike, if teachers as science communicators know and utilize the culture of the local people's everyday world. It is hoped that findings generated from the study can be used to help teachers reflect on their teaching practices so that they can consciously move back and forth between the public's everyday world and the worldview presented by Western science.

It was anticipated, moreover, that the outcomes of this research would help elucidate an understanding of the meaning of knowledge as a social and cultural construct and how the indigenous social and cultural milieu should inform educational policy, formal school curriculum, educational theory and practice. Since indigenous knowledge is a social and cultural construct, and formal curriculum is the product of selective traditions (Lawton, 1977), the two cannot be divorced from the contested educational terrain. The purpose of this study in the contested educational terrain was to establish the relationship between Western science and indigenous knowledge in the primary school science curriculum in Zimbabwe and ascertain how teachers mediate these two sets of knowledge for their students. I initiated the study with the hope that the findings would be of significant use to teachers and educational policy makers by way of offering insights and challenges to the conventional Western bias in teaching primary school science in Zimbabwe. I also embarked on this study in order to open up cross-cultural spaces for new research directions with respect to the history, origin and definitions of science in its local contexts, in this case, the Zimbabwean socio-cultural context.

Scope and coverage

This study focuses on teachers' experiences with respect to incorporating indigenous knowledge and languages in the teaching of science in a rural primary school in Zimbabwe. At this stage, the study did not intend to investigate students' interpretations of science, but how their teachers presented or mediated the science curriculum to them. Neither did the study intend to analyze the content of science textbooks, but to explore how teachers use the textbook during science lessons and the extent to which they use it as the predominant source of science knowledge. Therefore, interviews with students and content analysis of science textbooks were not within the scope of this study. Views of students on indigenous knowledge and science, and content analysis of science textbooks could be areas for further research. Because the intention of the research was to explore and discover what teachers do in their classrooms when they teach science and what they say about their attempt to incorporate indigenous knowledge and languages into the primary science program, the study uses semi-structured interviews and non-participant observation as methods for data collection.

The geographical coverage of this study was limited to one rural primary school, about 55 kilometers from Harare because the social, economic and political situation in Zimbabwe at the time would not permit broader scope and coverage. And because I lacked the necessary financial resources, I was unable to include more schools from different geographical regions and more participants in order to obtain more "extensive" and "representative" data for the study.

Research Questions

The study was guided by the following research questions:

- What are the educational policies that guide the teaching of science in primary schools in Zimbabwe?
- What do the terms “science” and “indigenous knowledge” mean to teachers, and to what extent do the teachers incorporate indigenous perspectives and indigenous languages into their teaching of school science?
- What are the teachers' sources of knowledge of science and what do they believe about the influence of students’ home culture on their success at learning science?
- What social interaction patterns can be observed in the classrooms during the teaching and learning of science?
- What are the teachers' experiences and concerns with respect to incorporating indigenous knowledge and languages for the purpose of devising a culturally sensitive science curriculum?

Definition of Terms

It is essential to provide conceptual or operational definitions for concepts that are central to this study. Indigenous knowledge or science is slowly moving into the literature of science education and its relevance is being challenged and questioned by the "scientific community." According to Baker (1996), there are three perspectives that challenge indigenous science/knowledge. The first is shaped by the logical empiricism that is usually identified with scientific inquiry. This view requires verifiable evidence in order to support any knowledge claim, so it rejects the notion that *science* can exist outside of the "scientific community" (Good, 1995; Williams, 1994). Advocates of multicultural science, in contrast, support the notion of a distinctive indigenous science and its ability to inform indigenous people to enrich "Western science" (Deloria, 1992; Stanley and Brickhouse, 1994). A third view is the socio-cultural perspective as expressed by Christie (1991), and its derivative, worldview theory, as expressed by

Cobern (1994) who has conducted research on the effect of cultural worldviews on science. Cobern does not contend that separate indigenous sciences exist, but rather that different worldviews interpret "reality" in different ways. So what is the difference between Western science and indigenous science/knowledge?

Western Science

Western science is considered as "the acquisition of systematized knowledge in any sphere of life (natural, social and behavioral spheres) by methods that are based upon objectively verifiable sense experience or verifiable observations" (Fisher, 1975 cited in Makhurane, 2000, p.64). Baker (1996) extends this definition by adding that science is essentially replicable observation, description, prediction, and experimentation related to the physical world. Jary and Jary (2000, p.536) provide a definition that is similar to Baker's and Makhurane's by stating that science is "the study of physical and social phenomena where this involves observation, experiment, appropriate quantification and the search for universal general laws and explanations."

Indigenous knowledge

Warren (1991) suggests that indigenous knowledge is the local knowledge - knowledge that is unique to a given culture or society. Although more widely shared locally than "specialized scientific knowledge," no one person, institution or authority possesses it all. It contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local decision making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural communities. Flavier *et al.* (1995, p.479) view indigenous knowledge as "the information base for a society, which facilitates communication and decision making. Indigenous information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems."

Baker (1996) observes that indigenous science differs from "Western" science in its method and rigor, but not in its meaning and importance. Like "Western" science, indigenous science consists of a set of explanations which seek to make sense of the natural world and which are consistent with a particular worldview. Indigenous knowledge/science is almost always relational in that it recognizes the role of the individual in the group and the group in its environment. Baker (1996) points out that the existence of indigenous science gives rise to a clash of worldviews and experience. Science teachers who work in the field of theoretical science were schooled within a Western scientific framework that predisposes them to readily dismiss the value of indigenous perspectives; either they are suspicious of them or they dismiss them as simply "unprovable myths" or "misconceptions" that certainly do not contribute to scientific understanding.

Summary

This chapter has described the situation pertaining to education and schooling in Zimbabwe, giving the background to the problem and the rationale for and significance of carrying out this study. The chapter has also presented the statement of the problem, the purpose of the study and the research questions that guided the study. The next chapter discusses the literature that deals with the hegemony of Western perspectives of science that dominate science education in Africa, and Zimbabwe, in particular. The literature explores various views and studies of indigenous knowledge and the teaching and learning of science.

CHAPTER II

LITERATURE REVIEW

Introduction

The education systems in postcolonial states in Africa appear not to have made much progress in shedding previously reified "modern" colonial knowledge to define and determine academic knowledge relevant for African societies and economies. Curricula in schools are deeply seated in the assumption that Euro-centric knowledge is superior to indigenous African knowledge, and this assumption is rife and regarded as "truth." The assumption has promoted the displacement and silencing of other belief and knowledge systems, which have largely been marginalized. In the process schooling, in its current structure, tends to impose and reproduce certain ways of viewing the world on the subordinate and marginalized groups. The reproduction of the culture of the dominant class in schools has a hegemonic effect that reinforces the fact that educational systems all over the world are not value-free and neutral. Schooling reproduces the cultural capital and worldview of the dominant social class in society.

In postcolonial states, like Zimbabwe, the reification of Euro-centric knowledge, which promotes the "superiority" of Western knowledge, is still perpetuated by the education system and schooling practices that negate the values of cross-cultural education and the role of indigenous knowledge in students' school experiences. Formal education (organized and institutionalized learning such as in schools and colleges) continues to be Euro-centric in outlook and academic in orientation, reflecting Western industrial and scientific cultures rather than the cultures of learners and their teachers. Schooling, curriculum content, teaching and learning styles run contrary to socio-cultural realities that students bring to the school site. The community's cultural knowledge constituting the informal learning that children experience in their everyday lives is discounted as irrelevant for schooling. Education that does not incorporate the life-worlds and lived experiences of students denies and prevents these students from actively engaging and participating in knowledge production.

Colonial Western knowledge as "academic knowledge": a modernist perspective

Kelly and Altbach (1984) describe colonization as a process whereby one nation or territory takes control of another nation or territory either through the use of force or by acquisition. In Africa, the colonizer wrongly perceived colonization as a process for and means of bringing modernity to societies considered being "backward" and living in the "dark ages." Colonization stripped the colonized of their indigenous learning structures and knowledge constructs and forced them to use knowledge constructs and learning structures of the colonizer. All this was done in the name of "modernity" and "enlightenment." Concerning modernity, Jary and Jary (2000, p.392) state that, "... in one of its senses 'modernity' is seen as identified with a belief in rationality and the triumph of truth and science." Seidman (1994, p.1) adds:

> At the heart of the modern West is the culture of the Enlightenment. Assumptions regarding the unity of humanity, the individual as the creative force of society and history, the superiority of the west, the idea of science as Truth, and the belief in social progress, have been fundamental to Europe and the United States.

The Enlightenment may, in principle, celebrate individualism and diversity; in practice, it is repressive. For example, the idea of social progress has been used to justify the destruction of local traditions and communities or to colonize non-Western people who were defined as backward or primitive. In this regard, through "modernity" the colonizers sought to assimilate the colonized into the foreign culture of the colonizer. According to Kelly and Altbach (1984), assimilation forced those who were colonized through cultural domination to conform to the cultures and traditions of the colonizers. The followers of Enlightenment philosophy used the school system and its "objective" and "rational" Western scientific knowledge to move forward their cultural and imperial agenda, which was justified as scientific progress. The claim that Western science was objective truth silenced local or indigenous knowledge and the social experiences that the knowledge expressed. This knowledge and experiences of the indigenous people were described as non-scientific, irrational and inappropriate. In this regard, Seidman (1998, p.314) concludes,

> In short, the chief ideas of the Enlightenment, the malleability of humans, the doctrine of social progress, the unity of humanity, and the truth of science, are viewed as part of the project of legislating order, controlling the unruly, labeling deviant those who differ or who do not conform to conventional norms of health, fitness, beauty, and virtue.

The agenda derived from modernity, for Western societies, was to bring "light", "civility" "rationality" and "social progress" to non-Western societies. Curiously, colonialism was often justified in the name of Western humanism. These notions, which were embedded in colonial thinking, and defined as modernity, were a ruthless, relentless drive to wipe out all "chaos," "ambiguity," ambivalence, difference, and "uncertainty" from the African face. As the heartland of reason and civilization, Europe was said to have its duty to spread enlightenment and progress to the rest of humanity. According to Bauman (1991), cited in Seidman (1998, p.314),

> The typical modern practice, the substance of modern politics, of modern intellect, of modern life, is the effort to exterminate ambivalence: an effort to define precisely - and to suppress or eliminate everything that could not or would not be precisely defined.

This spirit of control and intolerance characterized the modern state as it was perceived and defined by the colonizers. Bauman argues that the true spirit of enlightenment revolves around the quest for control and certitude. It is unfortunate that metropole/ colonial states, in their quest to control under-valued and marginalized local indigenous knowledge as unscientific and irrational, "replaced" it with Euro-centric knowledge for the purpose of "civilizing" the Africans. Euro-centric knowledge was viewed as the vehicle for social change, from an "irrational" and "primitive" society to a "modern" society.

Euro-centric knowledge was embedded in the myth of knowledge universalism. Western scientific knowledge, which was produced, universalized and exported to non-Western societies, was viewed as the vehicle for social change. It was also regarded as a benchmark by which the production of non-Western civilization was measured and knowledge defined and authenticated. That is how the myths on which Western ideas and thought are constructed and reframed as "global knowledge." In the process, however, Western cultural forms and realities, created and perceived as a mark of progress, induced historical, cultural, social and political discontinuity among indigenous people. Organized cultural, political, religious and economic institutions were disrupted. Recognized ways of understanding their world and realities were ignored and a *de facto* legitimization of Western views, which distorted indigenous lives, was imposed on local people. In other words, an adequate understanding of the reality *sui generis* of the indigenous society, which required an inquiry into the manner in which life and reality were constructed, was not sought.

Levine (1996) observes that "modern" science was used as an instrument of colonialism to universalize Western knowledge and in turn marginalize local knowledge frames and constructs that had existed for centuries. By "modern" science I mean the valorization and romanticization of Western thinking, which is viewed as rational and logical, as opposed to other forms of epistemological consciousness, such as indigenous thought. Western science is a Euro-centric social reality, lived social relations, and a socio-cultural and political construction. "Modern" science should be viewed as the production and reproduction of the Western life, a reflection of its social and cultural imagination.

Semali and Kincheloe (1999) and Shiva (1997) argue that modern science was used to produce "universal histories", define "civilization" and determine "reality." The net effect was the legitimization of Western ways of perceiving colonial life while concurrently delegitimizing the local indigenous social realities. This misrecognition of the *Other's* reality was hegemonic as it operated to characterize indigenous knowledge as inadequate and inferior. Giddens (1990, p.21) describes imposed knowledge as "disembedding…'the lifting out' of social relations from the social context of interaction…." The process of knowledge validation and truth claims was not considered in relation to the historical setting and cultural situatedness of indigenous people. The existence of Euro-centric knowledge and subjugated indigenous knowledge in Zimbabwe was [is] what Stoler (2000, p.74) describes as "two nations inside a society that will conceive itself in binary terms." Unfortunately, for those who sought to be assimilated into the Western culture, Euro-centric knowledge was treated and mystified as *sui generis* which could not be challenged while indigenous knowledge was a taboo and falsification that was not worthy of academic placement and enterprise.

Colonial Western science promoted a hierarchical and linear form of knowledge that dismissed other forms of knowledge (Shiva, 1997; Desai, 2001). The process of knowledge creation and questions concerning cultural assumptions and appropriateness in the use of knowledge were not deemed important. It was an all-encompassing program that was meant to disadvantage indigenous people by decimating their identity and psychologically displacing and severing them from their ancestral habitus. Their lives were penetrated by the ghostly presence of distant influences. According to Macedo in Semali and Kincheloe (1999, p. xi), colonial knowledge "exposed the fault lines of modernity grand narratives." It positioned the indigenous people on the margins, where-as subordinated cultural beings they struggled to make sense and understand themselves in relation to the imposed social environment bereft of their organized folk knowledge and cultural history. They were simultaneously ejected from identity-providing social contexts and confined to an alternative cultural world that was in confrontation and conflict with their respective definitions of reality.

The definitions and constructions of knowledge that were legitimized in Western philosophy and assumptions were key elements in a strategy that systematically led to social and political disempowerment and domination of the local people. Colonialism, and its knowledge constructs, was therefore a cultural invasion that imposed the cultural capital of the colonizer on the colonized. According to Thomson (2003), the replacement of African knowledge was initiated by ideological missionaries who challenged the indigenous metaphysical beliefs through religious education. wa Thiongo (1986) also adds that African epistemological beliefs were [are] also questioned via Western secular education that was introduced in Africa through colonization. The missionaries and colonizers penetrated the cultural context of indigenous Zimbabweans, disdainful of the latter's potentialities, the colonizers imposed their own worldviews upon the locals and inhibited the latter's creativity by curbing their self and cultural expression. Thus, using their cultural capital the colonizers imposed, sanctioned and controlled knowledge production and dissemination through the Church and the school.

Western colonial knowledge and Gramscian's cultural hegemony

Gramsci, cited in Lemert (1999, p.260), explains hegemony in terms of domination or command exercised by the dominant group in society. This domination is exercised through the State and "judiciary" government. The State and judiciary are not neutral institutions, but are sites of ongoing conflicts among and between various classes, genders, racial groups, ethnic groups and groups identified by their sexual orientation. However, since the dominant group controls the State and its functions, it controls the schools and the process of knowledge production and legitimation. Thus, the supremacy of the dominant social and cultural group is not achieved solely by physical force, but also through "consensual" submission of the very people who are dominated. According to Litowitz (2000), a dominant social group intends to "liquidate" or to subjugate antagonistic groups, and its supremacy manifests itself in two ways: as "domination" and as "intellectual and moral leadership" (Litowitz, 2000, p.516). Domination and leadership are exercised through power and cultural leadership. In the colonized nations, the colonial intellectuals were the dominant group that exercised both social and cultural hegemony in colonial societies.

Leach *et al.* (2001, p.294) point out that, "hegemony occurs when an already dominant social group, like educational and other professionals, establish the authority of its ideas and processes with other groups and thereby gains popular acceptance, even support." For example, colonial hegemony in Zimbabwe and elsewhere in Africa held that there were bodies of knowledge that were universally true, vested power in the colonial teachers, and put great faith in scientific notions of objectivity and reliability. This hegemony repudiated the view that acknowledged difference and diversity, and the notion that knowledge is socially constructed. Bourdieu and Passeron (1979) view cultural hegemony as the imposition by the dominant group of its cultural design through its possession of power, while its culture is reproduced and distributed by socialization agencies, including the school. Taking from Gramsci's use of the State and "civil society" in explaining hegemony, Giroux (1992, p.23) defines cultural hegemony as:

> the successful attempt of a dominant class to utilize its control over the resources of the state and civil society, particularly through the use of the mass media and

> the educational system, to establish its view of the world as all-inclusive and universal.

Cultural hegemony is a world-view that is perceived through tunnel vision and a "blinkered" pathway and a process that involves the struggle for power and control. It legitimizes the dominant-subordinate relations of inequality. The imposition of the culture of Western societies, for example, in Africa, resulted in the domination of the "white mainstream" culture over indigenous ones. Cultural domination was used to systematically reproduce the colonially established social order. Cultural imperialism and colonialism legitimized the false "superiority" of Western civilization while indigenous culture was regarded as "inferior." The colonizing groups imposed their views, beliefs, and culture, both explicit and implicit culture. Gramsci insists that, in colonial societies, relations of domination were replicated or reproduced in popular culture (Leach *et al.*, 2001). Thus, in Africa during colonization and even today, cultural hegemony can be seen in the form of the official language (English, French, and Portuguese), clothes, religion (Christianity), and other ways of viewing the world. Litowitz (2000) and Eze (1998) note that domination is increasingly a matter of colonizing the internal world of the dominated classes, a feat that can be accomplished through messages, codes, and the dissemination of images and information. The Church and school play a major role in this process.

For Eze (1998, p.141), cultural domination in Africa becomes one of drawing a contrast between a "dynamic modern culture" and a "static, traditional one," that is, between a "rational" West and a "mythical" Africa. Thus, domination or hegemony is not merely physical but also symbolic, and all political struggles are simultaneously struggles of art, media, communication, and so on. Cultural domination is embedded in a ruling worldview that requires the norms of universalization and rationalization (Eze, 1998). Through universalism, the dominant group manages to portray its parochial interests as the common interests of all people. Gramsci's point, according to Litowitz (2000), is that domination can be found at many levels of cultural totality - at the level of politics, education, religion, entertainment, news and commonsense. This means that domination is a complicated, multi-faceted and multi-leveled phenomenon. Shamai (2000) points out that hegemony is a class-oriented situation that is characterized by inequality in gender, race, and class relations. It is also reflected in the way that knowledge is created, packaged, disseminated and mediated. Formal education or schooling finds itself at the center of this hegemonic process since schools are involved in "engineering false consensus" through controlling the content of cultural forms that students are forced to learn.

Pierre Bourdieu and the cultural capital theory

Gramsci's concept of cultural hegemony is closely connected to Pierre Bourdieu's concept of cultural capital. However, while Gramsci's notion of hegemony is the perception that it involves struggle, Bourdieu's concept of cultural capital, on the other hand, is seen as a part of the reproductive process. These theories posit that the social world is that which the dominant group in society defines and that this results in the domination of other social groups. This domination is in the form of imposed cultural reality on marginalized groups and using educational institutions to reproduce the culture of the dominant group. Thus, this culture is defined as "**the culture**," which is then universalized through the imposition of the ideology of the dominant social class. The ideology of the ruling class, through its symbolic representations, is legitimized through the use of social institutions such as the Church and school. As Litowitz (2000, p.532) points out, Bourdieu reminds us of the "symbolic struggle" between "antagonistic world-views," with each view seeking to become a "legitimized vision of the social world." This antagonism exists between Western science and indigenous science. While Western knowledge constructs have been "universalized," "internationalized" and "globalized," indigenous knowledge is slowly finding its way into academic corridors. However, the social world and vision of the dominant social class becomes "fixed" in a way that preserves the hegemony of the existing system. The fixing of this social world is engineered through the cultural reproduction and class reproduction that the education system silently carries out. A capitalist system of education and its structured reward system are clearly identified as contributing substantially to the reproduction of social and economic differences among social groups. It is this same cultural capital that delegitimizes other cultural capitals as irrelevant and irrational.

Cultural capital is a theory of cultural reproduction, and reproduction of social inequalities through schooling (Bourdieu, 1974; Bernstein, 1971). Both Pierre Bourdieu and Basil Bernstein have drawn on the Marxist theory in developing this theory. Bourdieu and Passeron's (1979) notion of "cultural capital" is analogous to Marx's analysis of capital as an accumulation and reproduction process, while Bernstein's (1971) notion of restricted and elaborated language codes was partly inspired by the work of the Vygostsky. Livingstone and Sawchuk (2000, p.23) argue,

> While a great deal of contemporary learning theory takes a class-blind and individualist perspective, all of these social analysts have developed structurally grounded models of class differences in cultural sensibilities and linked them to differential social effects of schooling processes.

According to Seidman (1998), capital refers to resources or qualities possessed by an individual or social position that has social influence or currency. There are many forms of capital - economic capital (wealth), cultural capital (credentials and knowledge), symbolic capital (honor and prestige) and, social capital (social ties, networks and confidence). Bourdieu (1974, p.39) explains cultural capital as "culturally-valued tastes and consumption patterns that include a broad range of goods such as art, education, and forms of language." The concept of cultural capital, which involves socially legitimized linguistic and cultural competencies and affinities, plays a central role in Bourdieu's interpretation of the role played by education in the social and cultural reproduction process. Bourdieu (1973) insists that culture is an integral aspect of the social organization of domination, which in Gramscian theory is cultural hegemony. He argues that social class determines an individual's culture; both material and non-material culture. Moreover, culture reproduces class domination to the extent that the dominating classes can impose their hegemonic cultural values, standards, and tastes on the whole society, or at least install their cultural preferences as the standard of what constitutes the highest, best, and most legitimate in national culture (Seidman, 1998). In other words, cultural hegemony is utilized to impose class domination, which is accomplished insofar as the knowledge, lifestyles, tastes, aesthetic judgments, and social mannerisms of the dominating class become socially legitimate and dominant.

Class domination, through hegemony, is mystified or obscured by the ideology promoted by the dominating classes, which portray the most desired and valued cultural forms and practices as the product of gifted, talented, even charismatic individuals. These individuals, described by Gramsci in Lemert (1999, p.261) as "an elite of intellectuals," are at the forefront of reproducing class inequalities and cultural domination. It is vital to note that the class-dominant view of capital described here borders on being a monolithic Western sociological perspective that does not make allowance for non-Western views of cultural capital. This negation of indigenous perspectives on cultural capital reinforces the idea that Western knowledge seeks to trivialize and marginalize other worldviews and judge them as irrelevant and non-consequential. It is this view that was promoted, justified and applied by colonial governments to stamp out the proliferation of indigenous knowledge and languages. Domination of indigenous people was achieved through the formation of indigenous cultural elite who had acquired the cultural capital of the colonial ruling class. The indigenous elite control both the education and economic systems which are the major reproduction institutions.

Cultural capital is transmitted through a process of deep socialization. The family shapes the child's behavioral and cognitive dispositions. The child internalizes "a system of durably inculcated dispositions that structure both [the child's] behavior and her/his perceptions and representations of situations of action and of the social world in general" (Cronin, 1996, p.58). This implies that indigenous people do not necessarily acquire Western cultural capital because their socialization takes place within non-Western cultural locations and sites. These sites, principally the family and the community, engender the behavioral and cognitive dispositions that a child internalizes. These internalized dispositions are what Bourdieu (1984, p.468) calls "habitus, the internalized and embodied social structures." These are mental or cognitive structures through which people deal with their social world. According to McDonough (1998, p.184),

> Bourdieu uses the concept of habitus to refer to a deeply internalized, permanent system of outlooks, experiences, and beliefs about the social world that an individual gets from her [or his] immediate environments. Habitus is a common set of subjective perceptions held by all members of the same group or class that shapes an individual's expectations, attitudes, and aspirations.

Whereas Bourdieu appears to conceptualize habitus as permanent, I perceive it as elastic and fluid. It is not fixed and rigid since it can change over time through exposure to different social capitals and experiences. As individuals move from one field to another, acquiring new experiences and social networks, their social outlooks and ways of perceiving the social world change. Indigenous elites who have acquired Western cultural values or habiti through schooling and traveling in the global community have undergone this change. The notion that habitus is permanent is thus contestable. Bourdieu (1984) observes that social groupings cohere by virtue of similarities in habitus and fields, and also similarities in types of capital within the fields they occupy. Fields are the "networks of relations among the objective positions within it" (Bourdieu and Wacquant, 1992, p.97). The field is described as a "type of competitive marketplace in which various kinds of capital are employed and deployed" (Atkin, 2000, p.258). The social world is a web of intersecting multidimensional spaces and fields that include the economy, education, religion, polity, and the family. The notion of field seems to be always complemented by that of habitus.

It is important to note that indigenous people, in colonial times and today, are not socialized initially in a way that internalizes the beliefs, behavior and dispositions of the Western social world. They are socialized in the social worldview that portrays and represents the subjective perceptions, expectations, attitudes and aspirations of the family and community in which they are members. The colonial worldview that was imposed on indigenous people was a form of rupture that disconnected those people from their social and cultural habitus. It is this colonial worldview that was made the content of knowledge that was passed on to indigenous students through Western schooling.

Bourdieu's and other Neo-Marxist theories on schooling have been criticized for generally disregarding the school as a site struggling to create and integrate different social worlds and social relations in the production of knowledge (Lechte, 1994; Livingstone, 1994). They ignore the idea of agency that sees learners as independent in creating knowledge for themselves, the knowledge and cultural meanings acquired from their families and communities. For example, Bourdieu's concept of "cultural capital" places emphasis on the general cultural knowledge - sophisticated vocabularies and precise information. It also highlights how schools work, which children from higher status origins acquire cultural capital from their families and how the possession of these cultural tools lead to their greater success in school relations than working-class kids (mostly from indigenous groups in African communities). Livingstone (1994, pp.72-73) observes that:

> Such cultural theories offer considerable insights into the discriminatory schooling conditions faced by working-class people. But their prime intent has been to describe the cultural reproduction of inequality within fixed institutional forms. This makes them inadequate in [that]...they deny or denigrate the continuing capacities of working-class people to create cultural forms and meanings for themselves.

Livingstone's criticism equally applies to how colonial schools in Africa mistreated the indigenous people and their forms of cultural knowledge. Indigenous knowledge was ignored, denigrated and discounted as illogical and irrational. The trivialization of local knowledge resulted in it being left out of school curricula and educational pedagogy, thus preventing African students from achieving fulfilling learning experiences that represent their cultural worldviews.

Postcolonial knowledge: a legacy of Euro-centric hegemony and cultural capital

The determination of what counts as school knowledge, policies and decisions on **what** is to be taught and to **whom** it is to be taught is the prerogative of the State in Zimbabwe. The State controls the education enterprise and decides how it should be pursued. Postcolonial education is still largely based on educational structures that were imposed during the colonial era. The education system perpetuates a colonial legacy that continues to define school knowledge as a Western, empirically derived rational science. In addition, Western constructs and frames of knowledge still dominate school curricular and classroom practice at all educational levels. The importation of textbooks from Western publishers and the inclusion of literature that portrays life in Britain foster a dependence on alien definitions of knowledge. Postcolonial writers, such as wa Thiongo (1986, p.56), have criticized postcolonial knowledge, saying that:

> Education, far from giving people the confidence in their ability and capacity to overcome obstacles or to become masters of the laws governing external nature as human beings, tends to make them feel their inadequacies, their weakness, and their capacities in the face of reality and their inability to do anything about the conditions governing their lives.

Western culture, colonial and postcolonial curriculum, and pedagogical practices are deeply implicated in each other and continue to render formerly colonized, marginalized and repressed indigenous voices partially, and in some cases, totally silent. School knowledge continues to imprison the voice of the "voiceless" that are not actively involved in decisions affecting the schooling of their sons and daughters. The language of scientific investigation, English, which is also the medium of instruction in the delivery of the curriculum in Zimbabwe, makes the actions, feelings, attitudes and beliefs of the dominated culturally invisible. Writing on culture in educational institutions, Erickson observes that:

> Differences in invisible culture can be troublesome in circumstances of intergroup [*interknowledge*] conflict. The difficulty lies in our inability to recognize others' differences in ways of acting as cultural rather than personal. We tend to naturalize other people's behaviors and blame them - attributing intentions, judging competence- without realizing that we are experiencing culture rather than nature. Formal organizations and institutions, such as schools, become collection sites for invisible cultural [*knowledge*] differences (Erickson, 1997 cited in Desai, 2001, p.62).

Academics, teachers and policy makers have the challenging task of turning educational sites into cultural centers that accommodate inter- and multi-cultural sensibilities. Multicultural and multifocal methods, if used to define and construct **what** we know and **how** we know, will enable academics, teachers and students to use a variety of perspectives to invigorate discussion and excite their critical imagination (hooks, 1994). Changes in the school science curriculum and the incorporation of different cultural perspectives make it crucial that students and teachers learn to enter the school and classroom "whole" rather than as "disembodied spirit[s]" (hooks, 1994, p.114). The school and the classroom become dynamic cultural spaces where transformation in social relations is concretely actualized and the false dichotomy between the world outside and the inside world of the academy disappears. Teachers and students who are able to transform themselves are likely to be capable of transforming society. This self and social transformation requires teachers, students and policy makers who are critical thinkers and actors. Critical consciousness is fostered through exposure to different perspectives, not through the cultivation of a tunnel vision. Through critical consciousness, knowledge and critical thought engaged within the classroom should inform our habits of being and ways of living in a cross-cultural Zimbabwean society.

School knowledge in Africa has been and is still a colonial construct that undervalues the importance of local worldviews. It is Euro-centric and a result of the so-called modernity that was initiated by colonial hegemony. The Euro-centric Western knowledge was reified to the extent that indigenous scholars accepted it without questioning its legitimacy. It was accepted as a natural and significant "productive" process of giving meaning to our "new" world experiences. The reification of this knowledge led to the marginalization, social and political exclusion of indigenous knowledge in the school discourse by excluding the latter from the science curriculum and from official educational policy decisions.

One ramification of continued reification of Euro-centric knowledge is the myth that it is universal knowledge that permeates the everyday lives of all people. The myth is detrimental to positive social change because indigenous people find themselves being defined from the worldview of *others* who do not share their social and cultural world. Social development, within a group, should be viewed as a product of human experiences that occurs within a particular socio-cultural milieu. It derives from the people's everyday activities, how they define their social existence and how they define their future. Social change comes from the interrelatedness of existing knowledge constructs and people's experiences and how people utilize their knowledge. Freire and Faundez (1989) argue that indigenous knowledge is a rich basis for any justice-related attempt to bring about social change. Thus, indigenous knowledge should be brought to the fore of social change and development in postcolonial societies.

Indigenous knowledge/science and classroom pedagogy

Dzama and Osborne (1999) observe that there is a persistent thesis that attributes much of the difficulty that African students have in learning science and social development, in general, to the cultural conflict between their indigenous worldview and that of Western science that is taught as formal knowledge in school. Admittedly, there is evidence that traditional views do affect students' learning and social development (Jegede, Fraser & Okebukola, 1994). But, Dzama and Osborne (1999) argue that we know little about the relative importance of traditional beliefs or worldviews in comparison to other factors such as the ability to think rationally. Therefore, the indigenous elite, policy makers, teachers and academics that legitimate knowledge, especially school knowledge, should play a major role in re-framing and re-defining positively the place of local epistemology in the schooling enterprise.

Freire and Faundez (1989, p. 46) suggest that "intellectuals should soak themselves in this knowledge… assimilate the feelings, the sensitivity of epistemologies that move in ways unimagined by most Western academic impulses." Thus, the onus is on policy makers and teachers to facilitate and improve students' performance in science by taking their traditional beliefs and worldview into account. Ninnes (2000) found that in Canadian and Australian schools a variety of the social life and activities of indigenous people are presented in the *Science Probe* and *Dynamic Science* texts respectively. However, McConaghy (1998) found that the representations of indigenous people in these texts tended to be "traditional" and stereotypical and concluded that these types of presentations represent a form of cultural imperialism. Hodson (1993), cited in Ninnes (2000), also comments that the kinds of presentations of indigenous people in both Canadian and Australian textbooks, rather than boosting the self-esteem or enhancing minority groups' success in science, are careless and insensitive representations that may act against the interests of indigenous students.

Difference and diversity are at the core of contemporary society. These are pervasive and inevitable attributes of postmodern society. Educational institutions should treat with respect all versions of cultural capital and symbolic capital that belong to different social groups. Following Bourdieu (Litowitz, 2000) on the idea of the "symbolic struggle" between "antagonistic world-views", academics, teachers and scholars need to understand that the social world is a web of intersecting multidimensional spaces and fields. They should make these spaces and fields visible in their curricular and institutional corridors and theatres for students to smoothly move from one cultural space to another. Jegede (1995) suggests that one way for teachers to avoid assimilative practices is to sensitively integrate students' indigenous knowledge of nature with the content of Western science. A culturally-sensitive science curriculum would provide "science for all" aimed at developing in students the facility to cross cultural borders between their everyday world of family and friends into the "foreign" culture of the school science, without running the risk of assimilation (Aikenhead, 1997). Sutherland (1998) observes that many students do not cross such borders smoothly because of cultural conflicts.

When students move from their everyday culture into the culture of school science, the move is called "cultural border crossing" (Aikenhead, 1999; Giroux, 1992). Students need a teacher who is a "culture broker" for them to learn science in a meaningful way. Hazardous and impossible border crossings can cause students to avoid science classes altogether. Studies on cultural beliefs and science in Africa conclude that the teaching and learning of science in school is not successful because the subject is not linked to everyday life experiences of the students (Clark & Ramahlape, 1999; Dlodlo, 1999; Dzama & Osborne, 1999; Shumba, 1999). In a study conducted in South Africa, Clark and Ramahlape (1999) found that students underachieved in science because the subject is stereotypically presented as a fixed body of knowledge and as absolute "truth" in conventional textbooks and teaching. A culture broker science teacher will help students move back and forth, in hermeneutic fashion, between their indigenous culture and the culture of Western science, and will help students deal with cultural conflicts that might arise. It is pedagogically tragic that indigenous knowledge reflecting *Others'* reality is not given its proper place in existing curricular and curricular reforms in many postcolonial states today.

What is needed to transform science education in Africa is the inclusion of counter-inventions of the Euro-centricized knowledge in the language of instruction that presently lacks Africanness and African rationality. Dlodlo (1999) states that the usual justification for the use of foreign languages, such as English in teaching science in Zimbabwe, is that indigenous languages lack scientific terms. However, Dlodlo points out that in Zimbabwe, for instance, a student whose mother language has not been used in scientific discourse has very special additional difficulties of cognition and understanding. If the language of instruction is English, the student cannot "appeal to translation into the mother tongue for resolution of doubt or the dissipation of ignorance" (Strevens, 1976 cited in Dlodlo, 1999, p.322). The end result is "failure" to comprehend and conceptualize "facts" on the part of the student. Based on a longitudinal study in Nigeria, Bamgbose (1984) concluded that children taught in the home language performed significantly better than those in a control group in all subjects, including English. In a Kenyan study, Cleghorn (1992) discovered that when code switching into home language was used to foster understanding of key concepts, Grade 5 Kenyan students could use the home language (in this case Kikuyu) to write about the contents of a science lesson on water. In another study in Kenya, Bunyi (1999) found that when the use of English dominated in science instruction, students could not apply what they had learned to practical situations at home, thus documenting the subtractive nature of English. All these studies reveal the importance of using the home language to enhance students' understanding of science and making it meaningful to their realities. Dlodlo (1999) argues that the fact that science and technology in sub-Saharan Africa is not taught in an African language implies that no scientific ideas could be formulated in an African language or from an African perspective in the present education system.

The education system and pedagogical practices should transform learners from a traditional position of being *Objects* of learning to being *Subjects* who have important contributions to life and knowledge production in the classroom. Multicultural curricular and learning, which employ the student's mother tongue and the student's cultural experiences and life world, should be at the center of educational practice. In this way indigenous ways of knowing and acting could contribute so much to the educational experiences of all students and may instigate social action and social change in the Zimbabwean social and cultural locale. Semali and Kincheloe (1999, p.15) charge that academics in postcolonial states are "'academic gatekeepers' who use the rules of evidence (empiricism) and the dominant epistemologies of Western knowledge production to deem an understanding of non-Western knowledge irrelevant." This calls for the de-legitimization and re-scription of the unjustified dominance of Western, white mainstream, male knowledge and "expertise" in Zimbabwean educational thought. After all, as Young (2000, p.524) points out, "scientific truths are no more than what scientists, at a particular time, say is true."

The rejection of *Others'* knowledge denies subordinated indigenous people the possibility of using their knowledge as *truth* that can be used for academic capital that can be translated to economic capital for social and economic development. Indigenous knowledge is a powerful resource for overcoming indigenous peoples' social and economic subordination. It would be self-defeating; disenfranchising, disempowering and disenchanting for policy makers and academics in Zimbabwe to assert that Western experiences should continue to count as legitimate knowledge at the expense of other worldviews. Mental freedom leads to self-empowerment and emancipation from neocolonialism and inner colonialism. Mental colonization has a debilitating and debasing effect that leads to a profanation of the self and collective identity (wa Thiongo, 1986).

Indigenous knowledge: a constructivist reality

In light of new and emerging conceptions of learning in the literature, the educational community has begun to re-examine the concept "knowledge" and how it is constructed (Lauzon, 1999). The emergence of new conceptions of learning, for the most part, can be attributed to the growth of constructivism. Essentially this philosophical position argues that while learners may experience reality directly, the meaning of that reality is constructed; they construct and make sense of that reality themselves. Bednar *et al.* (1991), quoted in Lauzon (1999, pp. 262-263), capture the essence of this philosophical position when they write that:

> Learning is a constructivist process in which the learner is building on internal representation of knowledge, a personal interpretation of experience. This representation is constantly open to change, its structure and linkages forming the foundation to which other knowledge structures are appended. Learning is an

> active process in which meaning is developed on the basis of experience. This view of knowledge does not necessarily deny the existence of the real world, and agrees that reality places constraints on the concepts that are knowable, but contends that all we know of the world are human interpretations of our experience of the world. Conceptual growth comes from our internal representations in response to these perspectives as well as through cumulative experience.

From a constructivist perspective, knowledge arises from people's social, cultural and historical experiences. No knowledge is neutral, objective, absolute or value-free. It is embedded in people's cultural, social and political lives, and flows from ideological assumptions shaped by such factors as gender, class, ethnicity, language and religion (Dei, 1996). People's ways of thinking and knowing are rooted in their indigenous lives. It is knowledge that is not pre-specified but a product of experiences that are situated in the people's real world context.

Indigenous perspectives on learning postulate that learning environments are varied and situational, thus acknowledging the existence of multiple perspectives on knowledge and socio-cultural reality. According to Lauzon (1999), this explicitly acknowledges that values inform all knowledge construction and that, from a constructivist perspective, all knowledge is socially constructed. Thus indigenous knowledge is not "primitive" or "backward" as once portrayed in Western philosophical thought. It is a historical and social construction that stems from peoples' experiences rather than being O*bjects* in the margins in European experiences (Asante, 2001). In Zimbabwe, as in other parts of the world, indigenous knowledge has been marginalized since colonialism and continues to receive very little attention from educators and policy makers. While indigenous knowledge is regarded as belonging to pre-modernity or traditional societies, Western science, which defines Western knowledge constructs, is viewed as embedded in modernity. This "hierarchization" of types of knowledge gives unequal status and power to them and results in one type receiving less respect than the other.

Indigenous knowledge does not exist in a social vacuum, but in social, historical and cultural contexts. Semali and Kincheloe (1999) argue that as a body of knowledge, they belong to a community, and access to this body of knowledge is gained through contact with that community. Dialogue and collaboration are methods in the process of knowledge production. In order to acquire knowledge a learner must become directly and actively involved, or socially participate in a community. Learning from this perspective is a process of social interaction that takes place within a framework of participation whereby the learner acquires the necessary skills, tools, knowledge, beliefs and values to actively participate in the community (Lauzon, 1999). Learning is thus, strongly linked to the survival of the family and the community. However, the problem of defining indigenous knowledge and what it means to millions of indigenous people of the world is central to postmodern and postcolonial debates. Central to the discourse are the polemics of the origins of knowledge, the manner in which it is produced, archived, retrieved and distributed throughout the academy. Indigenous knowledge and its role in social development or change are seen as ambiguous, and most scholars and analysts are not sure what it means and entails. Chikako (2001:262), however, defines indigenous knowledge as "common knowledge shared by a community…has social, cultural, political and economic significance." And Kirkness, discussing Canadian Native People's traditional education, acknowledges that:

> From the scant knowledge that survived the many years of colonialism, we do know that our ancestors had evolved their own form of education. It was an education in which the community and the natural environment were the classroom, and the land was regarded as the mother of the people. Mothers of the community were the teachers, and each adult was responsible for ensuring that the child learned how to live a good life (Kirkness, 1998: 10).

Discussing the importance of the community and the natural environment, Mungazi (1996), and Mararike (1999) posit that among indigenous people in Zimbabwe knowledge and social reality are constructed around people's everyday life thus contributing to holistic and interconnected experiences. Therefore, indigenous epistemology is a representation of the local people's life constructed by the people and controlled by the people themselves through informal and non-formal learning situations. It is a set of representations of constructed local realities, which determine people's social being, thinking, behavior and connectedness. Indigenous knowledge gives people the power to control their lives and establish a relationship and connectedness with their social, spiritual and physical environment. It gives meaning to people's realities with respect to where they came from, where they are and where they are going (Chikako, 2001). Indigenous knowledge, therefore, is a social construct that evolves out of the peoples' social world and cultural experiences. The knowledge is a representation of reality as constructed and experienced by the people in their everyday lives.

Giving voice and space to indigenous cultural capital

In postcolonial African states, schooling essentializes knowledge defined in Western ethnocentric terms and rejects the authenticity of indigenous knowledge as an alternative worldview or social reality. The system has turned students into passive and docile *Objects* of learning rather than active and participating *Subjects* who are important contributors to knowledge production. Students' lived experiences are not given space in the current scientific and academic discourse in Zimbabwe (Shumba, 1999). Instead of providing conditions for students to speak, to come to voice, and to be listened to so that their narratives can be affirmed and engaged in school practices, schooling tends to silence them. As hooks (1989, p.12) points out, coming to voice would mean:

> Moving from silence into speech as a revolutionary gesture… the idea of finding one's voice or having a voice assumes a primacy in talk discourse, writing, and action…. Only as subjects can we speak. As objects, we remain voiceless-our beings defined and interpreted by others. Awareness of the need to speak, to give voice to the varied dimensions of our lives, is one way [to begin] the process of education for critical consciousness.

Giving voice to students can be achieved by employing what Giroux (1992) describes as border pedagogy. Border pedagogy views schooling as a process that involves a multiplicity of voices that typify the cultural dynamics existing in the classroom. Recognizing 'voices' empowers students to express themselves in defining what knowledge is and how it should be presented and learned, thus rupturing cultural and political boundaries and social margins that give privilege to some and exclusion to others. In a 3-year study of South African teachers who were taking an upgrading course in mathematics, Setati and Adler (2000) observed that in learning to cope with the discourse of a particular subject (in this case mathematics), learners had to move from their own informal, spoken language (L1 or main language) to the precise, formal language of the discipline (English, the target language). The goal of instruction, formal written mathematical competence, thus needs to be reached from a position of informal spoken mathematics rather than English, indicating interplay between accesses to meaning versus access to English. This is what border crossing is about, giving students space and the language to cross boundaries of differences. The interplay indicates that classroom voices are embedded in a language of hope (Freire, 1985) or language of possibility that is anti-hegemonic in which "one speaks *with* rather than *for* others" Giroux (1992, p.245). The language has the potential to create opportunities for students to exercise multiple realities, critical thinking, and cultural experiences that make them cross cultural borders in order to understand each other.

Crystal (1997) cited in Cleghorn and Rollnick (2002), estimates that more than 700 million school children throughout the world are taught in English, a language that may not be used at all in their homes or communities. Using a foreign language in the classroom inhibits students' free expression and conceptual comprehension and development. Language has a social foundation, and Freire's language of possibility has potential to free students from dominant classroom practices that stifle their participation in knowledge production. It offers teachers opportunities to construct classroom social relations based on notions of equity and justice. In African postcolonial states, the use of colonial languages - English, French and Portuguese that are grounded in institutional power that denigrates indigenous languages in classroom experiences - alienates and disenfranchises students from their learning experiences. This results in perceived academic 'failure.' Concerning colonial language, Giroux (1992) observes that the language of schooling is implicated in forms of racism that attempt to silence the voices of subordinated groups whose primary language is not English and whose cultural capital is either marginalized or denigrated by the dominant culture of schooling. Cleghorn and Rollnick (2002) report that at a conference held in Zimbabwe, one paper after another revealed problems stemming from the use of English as the instructional language and from a lack of understanding of the importance of culture in African L2 classrooms.

Transformative pedagogy

Giroux (1992) argues for a transformative teaching and learning pedagogy that engages teachers and students in a reflective, dialogical, open and critical way of thinking about knowledge and how it relates to students' lives. Dialogue and mutual respect of each other's cultures become vital to classroom social and power relations. The classroom is transformed into a place where categorizations based on race, ethnicity, gender, religion, social class and sexual orientation are reexamined and students are 'allowed' to explore these alternatives through critical thinking and self-evaluation. By redefining their new social positions and roles, teachers and students may redress inequalities perpetrated by Euro-centric knowledge constructions that are impediments to democratizing classroom practices in Zimbabwe. McLaren (1994) also argues against Euro-centric ideological distortions and totalizing forms of knowledge that create and give a false sense of equality and opportunity that the schooling often legitimates. He proposes to critique the positivistic, ahistorical and depoliticized discourse by re-mapping of history to counter unequal power relations based on master narratives, racism, sexism and those other relations of power that subjugate and oppress students.

Adding to the debate, Freire (1985) suggests that dialogue promotes shared cultural narratives without devaluing or marginalizing the historical experiences of 'Others', enabling rather than subverting the formation of a democratic and just society. Teachers can promote dialogue by encouraging multivocal pedagogies that give space and identity to students and themselves. Properly planned educational programs can give 'voice' to the marginalized, to the teacher at the chalkboard, to the parents attempting to improve the lot of their children, and the children themselves, bewildered by the problems of coping with the factors outside their control. This promotes reflective and transformative learning that is characterized by co-operation and acceptance of interchangeability and mutuality in the roles of teacher and learner. However, it should be noted that it is not easy for this form of critical pedagogy to be readily accepted by conservative teachers who are protective of their social positions in the social structure.

Aikenhead (2000), working with Aboriginal students in Canada, found that some students discovered that they already possessed some of the Aboriginal knowledge that was important for scientific conceptualization. The knowledge had been taught at home, but it was not highly valued at school as legitimate knowledge for school science. Clark and Ramahlape (1999), in a study on students' understanding of the concept "lightning" in South Africa, discovered that students could learn without fear or threat of ridicule from peers and teachers and engage actively in classroom discussions around something that was rooted in their everyday experiences. Knowledge that students bring from home and their communities stands out in students' memories as being much more "useful knowledge" than most of the other formal content of school science. I am not aware of any research that has been carried out in Zimbabwean schools to determine how teachers use students' home knowledge in teaching science. This study was conducted with the intention of filling that gap.

Knowledge hybridization for social change

In Zimbabwe, as well as other formerly colonized nations, knowledge is perceived in the form of binaries; indigenous /Western knowledge and traditional/modern beliefs. Seidman (1998) argues that by relying on binaries or hierarchical oppositions Western thinkers have sought to identify an order of truth and reality that could function as an authoritative basis for judging truth/falsity, knowledge/ideology, reality/illusion, or right/wrong. Although at a theoretical level binaries tend to exist between indigenous knowledge and Western science; an understanding of the importance of indigenous knowledge in school curricular cannot be achieved through these reductionistic binaries (Garcia Canclini, 1995). A closer look at contemporary society indicates that current knowledge constructs are not entirely Western, neither are they totally indigenous. There has been cross-cultural interchange between the two for more than a century since colonization. A hybrid of Western and indigenous knowledge has culminated in a new hybrid of knowledge. Knowledge hybridization is based on the notion that knowledge globalization and universalization are social and cultural distortions and myths.

Knowledge globalization and universalization imply similarities in bodies of world knowledge that can be found in all global spaces and societies. The view distances itself from the observation that each society has its own unique body of knowledge embedded in its history, culture and space. What has emerged in many societies, including Zimbabwe, is a hybrid of knowledge emanating from cross-cultural movements within and without national borders. Knowledge universalism is the illegitimate projection of Western values and power onto other global cultures. Tomlinson (1999, p.67), citing Gray (1997), states, "Universalism is actually a case of the particular disguising itself - *masquerading* - as the universal." Knowledge hybridization seeks to demystify, demythicize and deconstruct knowledge universalism and globalization. It is both an outcome and a relational process between forms of knowledge, whereby indigenous and Western condition one another. By virtue of the continued existence of indigenous knowledge, although marginalized, policy makers or academics cannot ignore the presence of local knowledge in the social milieu and social spaces they occupy.

The social world is fragmented into a multitude of communities, cultural traditions, and cultural modernity, all of which contribute to relevant knowledge constructs. Postcolonial Zimbabwe is a nation cut into the rural and urban binary, which are however not completely detached from each other. Placing knowledge hybridization in this context takes cognizance of the multicultural and multiethnic social structure of contemporary Zimbabwe and other postcolonial states. The co-existence of rural cultural traditions and urban cultural modernity creates a fertile space for a hybrid of knowledge. Thus, the principle of knowledge hybridization and pluralism runs against hegemonic practices, cultural imperialism, imposed Western values and cultural homogenization. It recognizes that there may be some common underlying conditions of existence irrespective of particularities, and that there may be consensual values and understanding constructed in respect of this commonality (Tomlinson, 1999).

The "structural duality" (Garcia Canclini, 1995) in urban and rural cultural versions, noted earlier on, strengthens the argument for cultural/knowledge hybridization. The duality creates a knowledge intersection between indigenous and Western knowledge made possible by creating a space for multiple forms of knowledge. Multiple forms of knowledge emanate from recognizing and realizing that knowledge is not an absolute social phenomenon and that no knowledge construct is superior to the other. There is no globally standardized and structured knowledge. Instead the knowledge that exists in the world is perspectival, cultural and relative to the world communities and the users of the knowledge. Educational policy makers, academics and teachers are the key agents in knowledge transformation, validation and legitimization and are responsible for its dissemination and implementation in educational institutions. These agents' attitudes towards knowledge definitions play a vital role in knowledge harmonization and hybridization.

Our voice, our space and our school: community and parental involvement

The existence of plural forms of knowledge means that teachers and academics are not the repositories and only source of all knowledge. Knowledge is a social and cultural enterprise and owned by various stakeholders. The community is one of the Bourdieuan *fields,* the home and the school the others, where students' *habiti* are shaped. Knowledge originates from these *fields,* and members of the community are legitimate co-creators of school knowledge. This implies that academics, teachers, students, parents and members of the community in which the educational institution is located need to work together cooperatively to determine and construct school knowledge. Giroux (1992) and Simon (1994) contend that education [schooling] is a contested terrain, which is traversed by competing and contradictory constructions of knowledge. The contestations and contradictions can be overcome if academic institutions take cognizance of the importance of the communities in which they are located. Local communities should be utilized as vital resources for knowledge production. Since knowledge is a product of people's socio-cultural milieu, communities are active *cultural fields* for creating knowledge. A close-knit partnership should therefore be established between communities and academic institutions. Effective partnerships can be inexpensive and simple, such as the establishment of a long-term arrangement between social studies teachers, sociology and anthropology academics and scholars, and local indigenous people. Students and scholars can go into the community to engage in hands-on research into the history and science associated with particular people in their locations and sites.

A broader educational partnership can be as comprehensive as to enable communities to systematically provide a curriculum with an indigenous focus (Freire, 1985). Academics, teachers and students would become cultural workers who transform institutions into cultural centers or spheres (Giroux, 1992) where the community gets involved so that schools can initiate pedagogies that constitute historical representations of difference. These representations would constitute an acknowledgement that multiculturalism is a feature of any contemporary society and of the schooling enterprise. Collective memories of the diverse cultural groups in society, owned by parents, elders and others, should make knowledge pluralism the essence of curricular reforms located at the intersection of cross-cultural texts and images (hooks, 1994). Cross-cultural texts and images give due regard to the diversity of the history of people who live in particular societies. Knowledge of the past is important in determining the present and the future aspirations of the people and how they can solve problems in their socio-cultural and socio-economic lives. Simon (1994, p.131) recognizes the importance of integrating the past and the present when he states:

> Acknowledging and grappling with the complexity of this assumed educative relation between present and past is important to those of us who - as cultural workers and teachers - create, organize, distribute and structure engagements with commemorations.

Commemoration, according to Giroux (1992), incorporates a set of evaluations that structure what memories should inform our social imagination from which social change emanates and from where knowledge pluralism arises. Parents and other members of the community are owners of this variety of knowledge.

Knowledge pluralism removes the teacher from the center of knowledge production and dissemination and transforms him/her into one of the participants in its creation. The community and the school become active co-participants in constructing and reconstructing school and classroom life. Hall (1996) perceives cultures as encompassing not only cultural institutions, but also symbols and representations. And who are in a better position to articulate and disseminate knowledge and its cultural symbols and representations than the local people are themselves? Local people, elders and parents find voice and space to use culture as a form of discourse to construct meanings that influence and organize actions and the meaning of science relevant to their communities. Their involvement in school life is likely to assist both teachers and students to redefine, reinterpret, express and act on school science critically. In essence, critical consciousness is necessary for social change and important in challenging hegemonic dominant knowledge constructs that are found and legitimized by colonial pedagogical practices (Freire and Faundez, 1989). Parental involvement provides a counter-commemoration to that portrayed by Western colonial knowledge and science in particular, that devalues indigenous cultural knowledge and science as baseless and unscientific. Teachers of science should aim at teaching for critical consciousness, teaching for development and social change and teaching for empowerment. By teaching for empowerment, they will transform both students and parents into agents of social change and community development (Freire, 1971). This may best be accomplished by recognizing that both Western science and local knowledge have an equal place in the science curriculum.

Knowledge pluralism and hybridization replaces the missing voice that was previously marginalized and subordinated by colonial educational practices. As Mohanty (1994) claims, education represents both a struggle for meaning and a struggle over power relations. When indigenous knowledge is incorporated into the science curriculum it neutralizes the power differentials created by colonial Western values. Involving academics, the indigenous elite, parents, elders and students as cultural workers within the institutional dynamics of educational corridors creates cultural spaces for equalizing oppositional histories of pre-colonial, colonial and postcolonial realities. Thus, the educational space becomes a central terrain where power and politics operate out of the lived experiences and culture of individuals and social groups situated in the asymmetrical social and political positions they occupy in society (Bernstein, 1996). A combination of stakeholders channeling their efforts towards an educational process that is inclusive and democratic is the precursor to effective and sustainable social change. We should realize that we are living in times of change and uncertainty, where many groups are challenging existing structures, calling into question previously held beliefs and ideologies.

Summary

Knowledge is a product of people's everyday experiences. It is particular to societies and it takes its meaning from the forms of life within which it is constructed and located. Anyone seeking to change the social and economic system of any people in Zimbabwe should first carefully examine existing indigenous knowledge and belief systems. Imposing dominant knowledge destroys the very conditions for local alternatives and diverse world-views to exist. Indigenous knowledge is made to disappear when the dominant system negates the very existence of indigenous knowledge or when dominant knowledge system erases or destroys the reality, which the local knowledge attempts to represent. Thus, education which is not a neutral endeavor and site should provide an enabling discourse that reflects and re-scripts scientific knowledge, a product of cultural and social diversity that exists in contemporary societies. The educational terrain should be a site for leveling power relations and empowering people by providing voice to teachers, learners and other community stakeholders interested in the education of their children. This constructivist paradigm of knowledge construction was the foundation for data collection and analysis for my research. The following chapter presents my theoretical perspective on the relationship between curriculum Africanization and cultural sensitivity in the teaching and learning of science in African schools, and sustainable community development. It makes the case for the need to redefine and reformulate the science curriculum to reflect the needs and realities of postcolonial societies, particularly Zimbabwe.

CHAPTER III

THEORETICAL PERSPECTIVES AND ANALYSIS

Introduction

The complex and crass politics of knowledge for development under globalization is a crucial issue in Africa. The dialectical relationship between education (knowledge) and development cannot be ignored. President Thabo Mbeki of South Africa captured this relationship when he said,

> I think all of us recognize that nowhere in the world has sustainable development been attained without a well functioning system of education.... We must proceed with ongoing African studies and research, into our rich past and rekindle interest into African knowledge systems, so as to make younger generations aware of the achievements emanating from our continent and impress upon them their inherent creativity, that is setting the stage for new developments and discoveries...for building mental universes of their own, for Africa's progress and prosperity (Mbeki, 1999).

Mbeki projects a view that is congruent with the desire to bring African indigenous knowledge to the fore of development. In Africa, personal, social and economic development cannot be divorced from the people's cultural and traditional worldviews. Sustainable development can only be achieved by incorporating indigenous perspectives on development. For people to benefit from any developmental projects, they need to identify with the knowledge that is employed to identify their needs. That knowledge should not contradict the way they understand their social and cultural conditions. Davies and Ebbe (1995) report that indigenous knowledge; the values, norms and beliefs embedded in the knowledge are an integral part of the development process of local people. According to the World Development Report (1998), knowledge, not capital, is the key to sustainable development. Building on local knowledge, the basic component of any country's knowledge system, is the first step to mobilize support for developmental plans. Therefore, developmental activities, especially those that aim to benefit the local people directly, need to consider indigenous knowledge in the design and implementation stages of the development process. An education system that recognizes the place of indigenous knowledge in the teaching and learning of science goes a long way in breaking the barriers that portray local knowledge systems as insignificant and unimportant. Indigenous knowledge/science should be the bedrock on which local developmental strategies are based.

Indigenous knowledge in the global context

Knowledge is indispensable for the promotion of social, economic and technical change in societies. von Liebenstein (2000) observes that a new dimension in the knowledge for development debate is the growing interest in the relevance of indigenous knowledge for sustainable development. While social and economic development is no longer the exclusive domain of Western science and technology or global knowledge, indigenous knowledge faces an onslaught from this so-called "modern scientific knowledge" whose purported "superiority" is driven by globalization. As a consequence, indigenous knowledge is sometimes dismissed as unsystematic, and incapable of meeting the productivity needs of the modern world. Historically, its oral, rural and "powerless" nature made indigenous knowledge largely absent from the global science arena. von Liebenstein (2000) concludes that the dismissal of indigenous knowledge as unsystematic may explain why Western science and technology still dominate development thinking and practice in "developing" nations.

Bhola (2002) observes that globalization is both old and new. It is old in being continuous with the age-old processes of colonization, decolonization and neocolonization. Colonization "universalized" and "internationalized" the Western concept of knowledge and science, while at the same time marginalizing and demonizing non-Western knowledge systems. The same Western knowledge and "scientific" forms were perpetuated after decolonization and have been maintained to this day. Bhola (2002) further contends that globalization is new in that electronic technologies have condensed time and space to create a postmodernist consciousness that has accelerated political, economic, social and cultural processes. Indigenous knowledge and ways of thinking are facing a cultural onslaught from electronic technologies that reify and mystify Western cultural realities. This cultural onslaught is resulting from continued cultural imperialism, which is being perpetuated and recreated by global processes. According to Dei (2002, p.167), "knowledge resides in the body and cultural memory; however, it is the Euro-centric gaze that has influenced and shaped what to see and not to see, what is [in]valid and [il]legitimate." Globalization has tended to validate and legitimate Western knowledge forms while marginalizing indigenous knowledge systems.

It is ironic that African intelligentsia, academics, and policy makers are themselves purveyors and promoters of the so-called global knowledge. Some of them (including me) attained their education and obtained their higher degrees from Western universities. They are "Westernized" Africans who have internalized the values, norms, and developmental concepts of the West which they, in turn, attempt to implement in their non-Western countries. The dispositions assimilated are, therefore, used to judge globalization, development, and indigenous knowledge with Western visions, Western assumptions, and Western criteria. Africans need to redefine their place on the globe. This means redefining education and development so that they reflect African thinking, vision and realities. New definitions of education, development and the self will build confidence and capabilities in the indigenous elite to be able to determine the role and possibilities of indigenous knowledge and its cultural heritage in science education and technological advancement. In this way, policy makers, academics and teachers will be comfortable articulating diverse expressions and other ways of thinking and of living in the world. They will become familiar with other relationships that exist between society and nature, and other approaches to the acquisition and construction of knowledge. As von Liebenstein (2000) concludes, indigenous knowledge is part of the "knowledge for development" debate; social and economic development is no longer the exclusive domain of Western knowledge.

The dialectic connection between education and development

In contemporary Africa, education and development are rooted in a historical, hegemonic and cultural imperialist perspective. They are age-old processes of colonization and the so-called Enlightenment based on positivist and modernist sensibilities. According to Bhola (2002), in developing societies Western political, economic, social and cultural processes have accelerated and intensified even after decolonization and political emancipation and freedom. These Western processes are used to define, determine and judge developmental activities in developing nations. Conceptions and models of education and development that were imposed by colonial regimes are still perpetuated and reinforced by current independent African states and are being constantly reproduced by the process of globalization. African countries, as with all other "Third World" countries, blindly bought into the concepts of education and development defined in the West, promoted by international development agencies, and drummed up by their own "Westernized" governing elite. As a consequence, what they have to show in the way of educational outcomes and development efforts, since decades of independence, are huge national debts. In many countries, servicing the debt takes half of the national revenue (UNDP, 1999), leading to poverty, diseases, hunger and malnutrition, high rates of school dropouts and unemployment.

Unfortunately, politicians do not fully realize the necessity of creating an education system that leads to sustainable development to meet the needs of the majority of the people. A redefined education system and concept of development should be truly non-Western, but local and indigenous. Policy makers should invent a vision and a program of development that is a product of African imagination, rooted in the values of African peoples, and is possible to achieve, not exclusively but essentially, using African resources - human, material, and spiritual (Bhola, 2002). This development would be measured, not by the rate of economic growth in a nation's Gross Domestic Product (GDP), but by success in the eradication of poverty from the nation's homes and communities.

The school, as a formal educational institution in Africa and other postcolonial states all over the world, continues to devalue, negate, and omit other forms of knowledge in its curriculum. Dei (2000) questions these devaluations, negations and omissions that have been long characteristic of schooling and school knowledge, especially, the near total absence of teaching non-European knowledge forms. These omissions have led to failure and meaningless forms of developmental projects that have not made life easier for local people in their communities. Education for development, to achieve the developmental needs of local people, will therefore have to be reinvented and redefined to take on the social and cultural realities of the local people into account. This means that which counts and passes as school knowledge has to take on a different meaning. Rather than defining knowledge in a Western modernist perspective, school knowledge, according to Abdi (2002, p.13), should be involved in the "'re-locating' of all cultures, backgrounds and even expectations for the noble purpose of community needs and development." The purpose of this type of inclusive schooling is to represent new possibilities for empowering the marginalized, thus giving them control of their lives.

Education as a tool for development

Education, formal, informal or non-formal, is perceived as a tool for development. It cannot be divorced from the cultural, social, political, economic and personal development of the members of society. Education is an ideological, cultural and continuous lifelong process of social learning involving both adults and young people learning from each other in formal and informal settings. It is a process of socialization that involves the transmission of knowledge, values, norms, beliefs, attitudes and skills important for human development. In most countries, education is considered an important element for development that empowers people so that they can make wise choices regarding their productive lives. There is an almost permanent relationship between education and social development (Abdi, 1998). Education is a precursor to development. It provides knowledge, skills, values, attitudes and dispositions that are vital for development-oriented individuals. However, the concept *development* is subjective, socially and culturally-constructed. Each society defines and gives meaning to the notion of development that reflects and portrays the needs of its people. It is a term that is not value-free. Because it is a relative concept, *development* takes on a multi-dimensional meaning involving changes in people's attitudes, the structures of society and social institutions. However, it is closely linked to the society's scientific knowledge and how it is utilized. Scientific, technical knowledge and skills that are generated through schooling should be relevant to the needs of the communities in which the students are a part. Where knowledge systems are at tangent with peoples' beliefs, social and cultural needs, development is likely to be impeded.

Knowledge has to be meaningful and relevant to be of any significant value to the society in which it is generated. Nyerere (1968), commenting on the need for *Education for Self-Reliance* in Tanzania, pointed out that for education to be meaningful it should not over-value book learning but foster values that make students understand why they are doing certain things. In other words, education has to be relevant and not isolate its participants from the society it is preparing them for. Nyerere was advocating for an education system that was embedded in the cultural values of communities, which stimulated the use of local knowledge and technologies. Education for development is reflected in the activities generated within communities. Members of local communities should be able to benefit from an education system that takes into account the relevance of local knowledge, and provide space for designing and implementing development projects that emerge from priority problems identified within the community.

Gorjestani (2000) observes that considerable progress has been made in promoting indigenous knowledge and that indigenous knowledge is increasingly becoming part of the development agenda, and that national initiatives and policies are emerging, yet some substantial challenges remain. Unfortunately, in the case of Africa, most decisions for community development emanate from central government; and the school system, itself, seems to be dislocated from the needs of the community. The science curriculum seems to continue to reflect Western ways of explaining phenomena, although the phenomena are located in African contexts. Thus, learners seem to be schooled for "global" rather than for the local community needs. What is required to alter and transform this worldview is to Africanize the schooling process and the school curriculum so that it reflects the African indigenous episteme and epistemologies.

An Africanized and culturally sensitive curriculum

The Africanization process involves making schooling and curricula culturally sensitive to the needs and aspirations of the African people the schools are supposed to serve. Africanization of curriculum entails bringing African indigenous realities into the school curriculum. Abdi (2002, p.21) says, "central to [Africanization] is to assume, exceptionally and when necessary, a tendency to indigenize both the production and use of knowledge so [that] these fit African needs, belief systems, and expectations for community development." Abdi, however, advocates for a relative Africanization of knowledge, which does not have to be entirely based on concepts, constructs, theories, experiments and laws that are purely produced by Africans or that are only applicable in African life systems. He advocates for the upholding of a multiculturalism of knowledge that does not necessarily exclude and alienate other forms of knowledge. Mataire (1998, p. 8), citing Henning Molberr, says about Africanization of knowledge,

> We are all part of this process and share the challenge of decolonizing and decolorizing the minds (including our own), moving towards a genuine common humanity based on dignity and self-respect of others and us. Such an achievement will finally result in an expression of self-respect, confidence and self-consciousness.

Decolonization and decolorization are strategies for countering and deconstructing Euro-centric ideological domination and hegemony in African schools. Schools should take cognizance of the societies in which they are located and the knowledge systems that exist in those societies. Educational policy makers should avoid misguided *educational* ideas that are based on illusions of certainty of knowledge. Those who plan and design educational curricular need to mentally and psychologically detach and disconnect themselves from former Euro-centric educational notions whose power structures were based on imperfect knowledge of indigenous African human resourcefulness and the colonial educationists' inability to contribute insights or knowledge from *alternative* resources. As Mungazi (1996, p.37) asserts, "To understand the African philosophical concepts is to appreciate the character of the African society itself." Education systems and developmental activities should be implemented using African philosophies in order for them to benefit the people. A schooling system that is responsive to the cultural needs and values of the society becomes responsible and accountable for the success of its students and the developmental needs of the local people who constitute a powerful sector on which the school depends for its success (Mudimbe, 1988). Appropriately designed educational programs need to reflect the cultural and historical backgrounds of the people, their desires and aspirations. The school should reflect the social life and experiences of the students, their homes and communities. Rodney (1974, p.239) aptly describes this relationship when he states,

> The following features of indigenous African education can be considered outstanding: its close links with social life, both in a material and spiritual sense; its collective nature; its many sidedness, and its progressive development in conformity with the successive stages of physical, emotional, and mental development of the child. There was no separation of the education and the productive activity. Altogether, through mainly informal means, pre-colonial education matched the realities of pre-colonial African society and produced well-rounded personalities to fit into that society.

Mungazi (1996, p.39) adds to this argument,

> While Westerners are obsessed with individual success, indigenous Africans are more concerned with moral values considered essential to the welfare of society. The welfare of society is a collective responsibility that involves the community and the ancestors.

Thus, schooling should emulate what traditional education was capable of achieving, bringing social life and the welfare of society into the classroom to make education socially and culturally relevant. Teaching and learning of science should be relevant and easily identifiable with the life experiences of the students and their community life. Science should not be understood as an abstract phenomenon that begins and ends inside the classroom walls. It should be linked to students' lives and meet their aspirations and their parents' desires for improving the quality of their lives and social conditions. Mudimbe and Appiah (1993) argue that there is a hugely oversimplified contrast between an experimental, skeptical science and an unexperimental, "dogmatic" traditional mode of thought. Mudimbe (1988) believes that the value-laden assumption that equates science to Western knowledge constructs deviates from addressing inclusivity, equity and the qualitative value of justice in contemporary African education.

Discussing schooling in postcolonial South Africa, Abdi (2002) states that learners should be capable of seeing, in science and technology, a place for themselves, for their cultures, for their languages, and for the overall South African multicultural space. In light of this, policy makers and political leaders must make a concerted effort to formulate and implement culturally sensitive and fully inclusive remedial programs that contain African scientific worldviews and ways of knowing. An inclusive science curriculum, or any knowledge for that matter, should lead to a transformed society. Dei (1998, p.512) sees the Africanization of knowledge as leading to a transformative African education in which:

> [The community] must find ways to tap the cultural resource knowledge of local peoples. Such knowledge was the hallmark of traditional indigenous African education. For example, throughout history, African parents and community members promoted learning among youth through community-and-home-based educational strategies. Rather than tapping such local skills and knowledge, colonial education chose to devalue and neglect home, family and community instruction strategies and practices. These strategies constitute an untapped resource that educational reformers could adopt to advance learning and teaching in schools.

Abdi (2002) describes the African philosophy that Dei advocates for as holistic and that it has always been the basis of African cognitive styles and methods of explaining, comprehending and relating perceived information. A holistic science curriculum could be implemented in schools so that the indigenous knowledge integrated in it could be used at the local level by communities as the basis for decisions pertaining to food security, human and animal health, natural resource management and other vital activities. In this way, indigenous knowledge as a component of school knowledge would be a key element of the social capital of the local people and would constitute their main asset in their efforts to achieve control of their own lives. For these reasons, Gorjestani (2000) suggests that the potential contribution of indigenous knowledge to locally managed sustainable and cost effective survival strategies should be promoted in the development process. Brody, Tomkiewicz and Graves, cited in Dillon (2002), concluded in their study of visitors' learning in an informal setting context in Yellowstone National Park in the USA that informal educational programs must take into consideration the personal existing conceptions of people and their socially-constructed meanings. Ignoring local needs and opinion and lack of respect for the ways of others leads to tensions and resistance, and offensive interference in their lives (Sillitoe, 1998). Abdi (2001) cites the example of apartheid South Africa where tension and resistance were experienced because the education system did not value the experiences, social beliefs and value systems of black South Africans. Tension can be reduced, if people tolerate and accept the existence of difference and diversity.

The language problem in African schools

The language of instruction in African schools is the major obstacle in students' cognitive development and learning outcomes. Today, African schools teach already codified texts, written more often than not in a Western language and projecting "unfamiliar Western epistemologies, Western ideologies, and even Western economic, political, and cultural contexts" (Bhola, 2002, p.13). Knowledge is embedded in language and African students must undertake dual translation to make sense of what they learn. They have to translate what is being taught in a foreign language to their mother tongue and then retranslate it to the same foreign language in order to communicate their ideas to the teacher. There is an intimate relationship and connection among language, meaning making, and practice, and the language educator/teacher must play an important role in guiding students through the many different cultural, linguistic, and cognitive borders that students encounter in the school setting (Cleghorn & Rollnick, 2002).

To the extent that what is taught in school reflects Western culture, which is associated with English or French speakers, African students are denied the opportunity to learn in a language that is familiar and meaningful to them. Cleghorn and Rollnick (2002), report that the content of the curriculum in African schools is foreign and also violates indigenous norms, values and beliefs. And in that case, one can say that English or French, the language of instruction, supports acculturation, if not assimilation, into another way of looking and another set of societal norms. The effect of this acculturation is a disjuncture between the culture of the home and the culture and language of the school. To overcome the language problem in the classroom, sometimes teachers and students resort to code-switching that is, moving from English to the mother tongue in order to clarify concepts and meanings. Adendorff (1996) and Eastman (1992), cited in

Cleghorn and Rollnick (2002), argue that although teachers often seem to hold negative attitudes toward code switching, there is considerable evidence that it can offer a natural, economical, and effective resource for establishing meaning in classrooms where the teacher and the students can communicate in the same home language. Dei (2002, p.175) supports the use of both languages (colonial language and home language) which he calls "language integration" and "an educational inclusive practice." Because meaning belongs to culture rather than simply to language, code switching can facilitate the establishment of meaning by providing a linguistic and cultural bridge to understanding.

One's language is vital in understanding the cultural reality that surrounds one's life. Fisherman (1996), quoted in Kirkness (1998, pp.10-11), says about the relationship and importance of language and culture,

> Most of culture is in the language and is expressed in the language. Language is best able to express most easily, most accurately and most richly, the values, customs and overall interests of the culture. If you take language away from culture, you take away its greetings, its curses, its praises, its laws, its literature, its songs, its riddles, its proverbs, its cures, its wisdom, its prayers. You are losing those things that essentially are the way of life, the way of thought, the way of valuing, and a particular human reality.
>
> Put in another way, we speak of the sanctity or sacredness of language. It is our unique gift from the Creator, therefore it is the mind, the spirit and the soul of people. Language is important because it is what ties us together, as in a family. Losing a language would be like losing a member of one's family, an article of faith, and a commitment in life.

What Kirkness says about the connectedness of Aboriginal language and culture equally applies to African languages and culture. You can neither break away African languages from their cultures nor disconnect culture from language. The two have a dialectical relationship that gives meaning to the lives of Africans. Therefore, using a foreign language, as the language of instruction, deviates from the African indigenous cultures and knowledge and virtually ignores the indigenous values and beliefs that should enhance and assist students to understand the teaching and learning of science.

Summary

Education for development that is conceived within the global network of knowledge needs to be reinvented. According to Bhola (2002), education should be designed to meet community-centered needs and for the social reproduction of labor for the newly developing service and industrial economies that are emerging in Africa. To be able to meet the needs of the community, Obanya (1999, p.3) advocates for "enculturation before acculturation as Africa's number one educational goal, with a call for African cultural values, African indigenous knowledge, African indigenous languages, African societal resources to be fully mobilized as essential inputs" into education. This Africanization of education would counter the hegemonic effects of globalization from above, which is imposed and dictated by the West. However, to meet the needs of a developing economy, school knowledge must be a hybrid of both African indigenous knowledge and the "scientific" knowledge of Western education systems. Education in the globalization age should therefore be the balanced integration of global knowledge and indigenous knowledge. Western science and technology must go hand-in-hand with indigenous or local knowledge for sustainable development in any community, international understanding, and peace and harmony of the world.

Whereas the previous chapter discusses Gramsci's and Bourdieu's theoretical concepts of cultural hegemony and cultural capital/reproduction that oppresses marginalized groups in society, it also discusses how people are capable of constructing meanings from their socio-cultural world. In spite of cultural domination, since people have agency, they are capable of creating their own world. They can make social and cultural constructions that are based on their own social and cultural realities and experiences. Thus, the next chapter shows this rupture from domination to agency by discussing the constructivist paradigm and qualitative methods that were applied in the field study phase to obtain and analyze data that sought to answer the research questions that guide this study.

CHAPTER IV

METHODS

Introduction

This qualitative and constructivist-interpretive case study is an exploration and description of the experiences of ten rural primary school teachers in teaching science using indigenous perspectives in Zimbabwe. The research process and questions, and the expected outcomes were the reasons that led me to opt for the qualitative methods of inquiry applied in this study. The goal of this research was to gain insight into these teachers' classroom experiences in utilizing indigenous knowledge in teaching science. In order to arrive at in-depth insights and understandings, a constructivist-interpretive paradigm was found appropriate for the current study. According to Guba and Lincoln (1994), a constructivist paradigm enables the researcher to obtain multiple constructed realities (the social construction of knowledge relativist ontologies) from research participants. The interpretive-subjectivist epistemologies in this research allowed the researcher and the researched to interact and shape each other's understandings of the studied phenomena (Denzin and Lincoln, 1994). The present chapter discusses the methods of data collection and analysis that were used to arrive at interpretations of findings in this study.

Multivoices and multirealities: theoretical concepts

This research, on indigenous knowledge and the teaching of science in Zimbabwe, is embedded in postmodern sensibilities. Postmodern sensibilities recognize that science is not a static and fixed story, one story that silences other existing voices. Rather, there is dynamism and plurality in science and as Denzin and Lincoln (1994) assert, there are other multi-voiced stories or texts that denote science. This observation is related and linked to the constructivist paradigm, which establishes the understanding that people construct meaning out of their social and cultural realities. Since people are both the creators and the object of knowledge, theorists who advocate for the multi-voice approach argue that the construction of knowledge has to be engaged, perspectival, hermeneutic, and pluralistic rather than absolute, monolithic, and abstract (Bogdan & Biklen, 1992, Creswell, 1994). Therefore, science as a socially and culturally constructed phenomenon has a multi-dimensional reality. According to Creswell (1994, p.8), "multiple realities exist in any given situation..." and, a researcher who believes that this is the nature of reality needs to apprehend and report them, a process that is made possible by qualitative inquiry. Thus, through postmodern sensibilities, this research explores how primary school teachers understand, interpret and give meaning to the science that they teach in their classes and how they represent and present various social realities in the science curriculum, and in their teaching.

Silverman (2000, p.171) supports a multi-voiced interpretive and constructivist research paradigm by arguing that, "The deconstruction of a single authorial voice... [enables] multiple readings of text and data...." Green (1994), cited in Ellis (1998a, p.9), asserts that, "[It] allows no one truth, no single monological description of physical and human phenomenon." Thus, this research explores representations of realities in science in primary schools in Zimbabwe. A multi-voiced approach embedded in multi-reality perspective was, therefore, a useful guiding philosophical consideration for the study.

Positivist and post-positivist researchers are skeptical of postmodernism and criticize it as not scientific. They dismiss it as deficient and lacking empiricism. However, postmodern sensibilities take into account the consciousness of participants by engaging them in dialogue, capturing their sentiments, points of view and everyday experiences (Moss, 1994). Through dialogue, we share knowledge and develop a fuller understanding of the social world we inhabit, unlike positivists who objectify social reality and the social reality. Situated or contextualized knowledge, which is advocated by constructivists, is part of our everyday encounters and experiences. We construct interpretations and meanings, and construct our worldview from our everyday experiences and encounters. Ellis (1998a, p.8) explains this when she argues, "Today's postmodern precepts of situated knowledge, contextualized knowledge, and embodied knowledge represent a valuing of grounded knowing rather than a devaluing or dismissal of partial or perspectival knowing." Contextual texts or narratives provide a rich and deep description of events, which make qualitative inquiry a lifelike process, which is not alienated from the experiences of participants in their communities. What counts as knowledge is "a consciousness open to a reality shared by a community" (Ellis, 1998a, p.8) and "modes of interpretation arise from a community" (Greene, 1994, cited in Ellis, 1998a, p.8). Thus, postmodern sensibilities as the framework for this qualitative research, intends to address the multiple realities of science in its situated contexts as perceived by teachers in this study.

Rationale for qualitative inquiry

The nature of the research questions, the research process and the expected research outcomes determine the research methods for any study (Silverman, 2000). If the study focuses on in-depth insights and experiences of participants, a qualitative inquiry is the method to follow. The goal of the present research was to collect in-depth data and craft a holistic picture of the teaching of science using indigenous knowledge and languages in the classrooms of the ten teachers in this study. The research questions and the methodological process resulted in the collection of "thick descriptions" of qualitative data that portray the experiences and insights of the teachers in teaching science lessons. Creswell (1998, p.15) defines qualitative research as,

> An inquiry process of understanding based on distinct methodological traditions of inquiry that explores a social or human problem…and the researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants and conducts the study in a natural setting.

Denzin and Lincoln (1994, p.2) point out that:

> Qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret phenomena in terms of the meanings people bring to them.

An emphasis on process and an in-depth understanding of perceived meanings, crafted interpretations, and behaviors, in contrast with the measurement of the quality, frequency, or even intensity of some externally defined variables, is the foundation of qualitative inquiry. The above definitions of qualitative inquiry imply that qualitative research is largely inductive rather than deductive. An inductive approach implies that a researcher attempts to gain an understanding of the patterned meanings, perceptions, beliefs, values, and behavior of a particular group of people or phenomenon in relation to a research problem (Creswell, 1998). The inductive process is neither about quantifying data, nor testing hypotheses and objectivity. Rather, it is an on-going process that involves the interconnectedness of pieces of evidence to shape the whole picture of events. It is vital to understand this interconnectedness, which can only be achieved by studying a phenomenon in its natural setting. In this study, I attempted to elicit, from teachers, their understanding of the interconnectedness of indigenous knowledge and Western science. Evidence was collected from the ten teachers in their natural working environment, the school and the classroom.

Traditionally, knowledge building is based on quantitative principles of objectivity and generalizability, following canons of the scientific method (Jansen & Davis, 1998). For quantitative researchers, knowledge building is the construction of reality that follows the logical-positivist model, offering generalized findings from a dominant cultural perspective. On the other hand, qualitative research entails giving voice and listening to the experiences of others, and understanding their experiences within their social worlds. Denzin and Lincoln (1994) point out that this type of research is atheoretical. By this they mean that in qualitative research the cause-effect variables cannot be easily identifiable, and theories are not available to explain the behavior of participants (Creswell, 1998), the theories are developed in the course of the study. Denzin (1989) acknowledges the postmodern concern about the role of the researcher in interpreting a study, rather than the traditional, theory-oriented classical approach. The emphasis in my research is not on establishing the validity and generalizability of findings, but on establishing meanings and giving subjective interpretations to events such as understanding experiences of teachers in the social context of their classrooms. The intention of my study was not to make generalized conclusions about primary school science teachers in Zimbabwe, but to document experiences of specific and particular teachers who participated in this study. The intention was neither to prove a theory nor determine the validity of data, but to collect thick descriptions of teachers' interpretations, understandings and perceptions of science and their experiences in using indigenous knowledge and languages in teaching science.

In qualitative inquiry, the focus is on the subjective experiences or interpretations of participants in giving meaning to their social world. Embedding research in the lived experiences of the participants involves a holistic and unfragmented approach. This implies locating research in the texts, and voices of the participants in their natural social settings. In my research teachers were videotaped while teaching science lessons. They were also audiotaped during interviews. Participants were not treated as *Objects* of research but as *Subjects* with voices that would contribute to the research process. The research process itself was generative (Peshkin, 1993) since data were generated during interaction with teachers in their social milieu, the classroom. Thus, the participants and researcher collaboratively created knowledge from their interactions during class observations and interviews. In this respect, the researcher and participants were equally important elements of the research process.

Unlike quantitative research, which views knowledge as objective truth "out there" to be discovered and verified, qualitative inquiry treats the researcher and participants as insiders working together to produce, re-examine and reproduce knowledge and construct social reality from a particular social situation. Although qualitative research is criticized for being subjective, unscientific or lacking rigour (Mishler, 1990), its strength is found in treating participants as agents or partners in knowledge construction and as human beings beyond quantification. It respects the contribution of participants and aims at getting the significance of their voices, actions and meanings. In qualitative research the researcher is the key instrument of data collection (Bogdan & Biklen, 1992) and in total control of the research process, however, guided by the interaction that takes place with research participants. Therefore, in this study I had personal contact with the teachers in order to obtain insights into their classroom situation and how they made sense of indigenous knowledge and science, the phenomenon that was under study. Personal contact during observations and interviews made me context sensitive in order to place findings and interpretations in a social, historical and temporal context.

Constructivist-interpretive case study

This research employs one version of qualitative research, the constructivist-interpretive case study method. The research paradigm and method was selected because of its focus on the collective social construction of knowledge. It also relies heavily on the subjective constructions of multi-realities and their culturally constructed meanings. The constructivist paradigm focuses on situated knowledge, which is created by individuals within their social settings/situations. It is especially appropriate for this study on teachers' constructions of scientific knowledge and how they mediate it to their students using indigenous perspectives. Teachers and students come from different cultural backgrounds and, thus, are likely to encounter and interpret knowledge and give meaning to it using different cultural perspectives. Therefore, the case study was used to obtain data on teachers' interpretations and meanings of science and how these are mediated to make the learning of science a meaningful and rewarding experience for students.

Constructivism

Guba and Lincoln (1994, p.125) present constructivism as a mode of inquiry which adopts "a relativist ontology, a transactional epistemology, a hermeneutic and dialectical methodology." The inquiry aims of this paradigm are oriented towards the production of reconstructed understandings, and the social constructions of knowledge. Stake (1995, p.99) defines constructivism as "the belief that knowledge is made up largely of social interpretations rather than awareness of an external reality." Constructivism is an alternative research paradigm to the traditional positivist criteria of internal and external validity, which parallel *trustworthiness* and *authenticity* in qualitative research. Researchers using this school of thought are more interested in the construction of knowledge among participants as well as co-construction of knowledge between the researcher and the researched. Thus, knowledge that emerges from the research process is a product of multi-realities rather than mono-reality.

Guba and Lincoln (1994) posit that knowledge and interpretation in constructivist research is thus the result of a collective, not an individual process. In the current study social constructions of science knowledge were studied within the totality of classroom activities, focusing on how teachers and students shared experiences they brought to the classroom situation. Following a constructivist argument, realities brought into the classroom should be comprehensible in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature. So this study looked at how teachers brought the local, specific, experiential and social realities into their teaching of science. Stake (1995, 2000) points out that, constructions of meanings, understandings, and interpretations come from experience and from being told what the world is like. In light of these views, teachers' and students' constructions of science within the indigenous perspective, the dispositions they were socialized in, were central to my study.

Since indigenous knowledge and languages play a vital role in students' constructions of their worldview, it was my intention in this study to learn how these experiences were utilized in teaching science in primary schools in Zimbabwe. Of crucial importance to this study was how teachers validate knowledge. One aspect of the study was to determine whether teachers considered science knowledge as absolute or relative to social and cultural realities. The other was to discover whether teachers created spaces for students to connect classroom science knowledge with their prior experiences as a way of making sense and interpreting what they learned. I intended to make sense and meaning of teachers' roles in facilitating multi-voice reconstructions of science knowledge using the vicarious experiences of students. Guba and Lincoln (1994) suggest that one important mechanism for transferring knowledge from one setting to another is the provision of vicarious experiences, often supplied by case study reports. Thus to obtain these experiences of the ten primary school teachers in Zimbabwe the interpretive case study was chosen as the appropriate research approach.

The interpretive case study

I selected an interpretive case study for my study because of its methodological, structural and procedural flexibility as well as the need to understand teachers' classroom reality in their natural setting. According to Gray and Airasian (2000, p.627), case studies involve "the collection of extensive data on many variables over an extended period of time, in a naturalistic setting, in order to gain insights...." Merriam (1988, p.54) describes a case study as "an exploration of a bounded system or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context." Thus, a case study is an intensive, holistic description and analysis of the phenomenon or social unit being studied. In my study, the classroom was the bounded system within which teachers were the cases or the social units being studied. In-depth data were derived from observations of the activities and interactions that took place during the teaching and learning of science and through interviews with teachers.

Denzin and Lincoln (1994) and Yin (1993, 1994) say that the case study is an endlessly creative and interpretive method, with interpretations constructed during the course of research. A case study is done by giving special attention to the completeness in observation, reconstruction, and analysis of the cases under study. Although I was using a video recorder to capture activities in the classrooms, it was not possible to capture the entire classroom at one instance. This meant that it was possible that some events outside the camera's focus could have gone unrecorded. However, I made effort to remain focused and to capture as many of the happenings as possible.

Morse (1994) advises that interpretations occur as events unfold and these interpretations can be reinterpreted and questions reformulated or reframed as new evidence emerges. Ellis (1998b) describes this process as the unfolding spiral of the hermeneutic circle. In my study I attempted to pay as much attention to the class activities and conversations between the teachers and students and among students themselves in order to make meaning of what was happening. In addition, during interviews/ conversations I listened more than I talked to gain teachers' insights. These actions assisted me in framing and reframing questions that provided in-depth insight and information. At times, I had to question and follow up on what appeared out of the ordinary and note what needed to be clarified later in the research process.

Interpretations were influenced by what was uncovered by the previous inquiry circle or observation. To make sense and meaning of what was being presented by the teachers I had to interpret, reinterpret, and reformulate my research questions according to the insights arising from my analyses throughout the duration of the research. Data that were collected are subjective and open to various interpretations and their meaning depends on the social situation and context in which they were collected. Thus events and activities that occurred in the classrooms determined the interpretations of data that I collected from the ten teachers in the school that I visited. The data and conclusions reflect both the views of these teachers and mine. They do not in any way represent the views and experiences of all primary school teachers in Zimbabwe, either rural or urban.

Interpretive case studies allow long-term and face-to-face interactions that validate the worldviews of participants in their own words. Tellis (1997) points out that case studies are multi-perspectival in that the researcher considers not only his/her voice and perspective, but also of the actors and the relevant groups of actors and the interaction between them. Interpretive inquiry allows for varied voices to be heard and all are allowed to speak, even to interrupt and contradict one another. No voice can represent the other; individuals express their own worldviews and experiences. In this study, personal contact with teachers and students gave me access into their worldviews on indigenous knowledge and science. By listening to their personal exchanges, observing activities and interactions in the classroom, I was able to interpret social and power relationships that existed in the classroom.

It was from the data on teachers' and students' classroom activities that I was able to make and unmake interpretations that became the "big story" on teaching science in **those** classes and in **that** rural primary school in Zimbabwe. Silverman (2000) argues that because interpretations are constructed, they are contingent and alterable; their contingency provides the freedom for new interpretations. In this sense I was flexible and open to adopting new interpretations as understanding of the classroom activities deepened. I pursued interpretations of meanings of indigenous knowledge and science with a constant hermeneutic movement back and forth between meanings established by teachers and a web of meanings provided by students. In this way the interpretation reflected the relationship between the parts (micro) and the whole (macro) phenomenon.

The research site and context

In case studies the social context in which social interactions and activities take place are vital to the study. Creswell (1998) observes that the context of the case involves situating the case within its setting, which may be a physical setting, or the social, historical and/or economic setting. The rural area where the school I visited is located determined the social and cultural setting for the cases in the study. Rural schools are sites where indigenous knowledge and languages are most likely to be incorporated in teaching across the curriculum, including in science. Denzin and Lincoln (1994, p.202) justify the selection of a particular setting or site for study by making the following observation, "... They [Researchers] seek out groups, settings and individuals where... the processes being studied are most likely to occur." Rural schools are located in communities and localities where indigenous Zimbabweans live and where indigenous knowledge and languages are deeply seated in their life experiences, so the choice of a rural school as my research site was based on this logic.

The research site for this study was a school that is 55 kilometers from Harare, the capital city of Zimbabwe. The current volatile political situation in Zimbabwe did not permit me to visit remote rural areas. Besides the unstable and volatile political situation, the country is also experiencing an economic meltdown that has resulted in the shortage of fuel. This was a major setback, since I could not travel to schools that were very far from Harare. In addition, the high inflation rate of 650%, at the time, made the cost of hiring a vehicle prohibitively expensive since I had no financial assistance to conduct the study. As a result, I had to depend on equally expensive public transport for all my visits to the school. These factors resulted in my decision to limit myself to one rural school that was within reasonable distance from Harare.

The cases/participants

Because the nature of this study was to explore and describe rural primary school teachers' experiences in incorporating indigenous knowledge and languages in teaching science in Zimbabwe, I felt that a sample of participants (though small) of varied ages and teaching experience was necessary. I assumed that age and experience would influence teachers' perceptions and experiences in using indigenous knowledge and languages to teach formal science. However, I had no influence on selecting the teachers since the grade levels I was interested in guided my selection. My research interest was in classes that use a foreign language, English, to teach formal science in a rural primary school in Zimbabwe. The teachers' gender, ages and teaching experience are shown in Table I below.

Table I

The age and teaching experience of teachers in this study

Grade	Gender	Age	Teaching Experience
4A	Female	26	1
4B	Female	40	17
5A	Female	29	5
5B	Male	43	17
5C	Female	32	8
6A	Male	30	7
6B	Male	36	13
7A	Male	34	10
7B	Male	39	9
7C	Male	35	9

The ages of the teachers who participated in this study ranged from 26 years to 40 years. Two teachers were in their 20s, six in their 30s and the other two were in their 40s. The teachers' ages do not appear to have influenced the allocation of classes. However, what seems to be a factor in the grade level allocated to a teacher is the gender component. As illustrated in Table I, female teachers in this study teach middle grades, 4 and 5, while male teachers teach upper grades, 6 and 7. The experience of teachers ranged from a student teacher who had one year to two teachers who had seventeen years of teaching experience. The majority of teachers in the study, seven of them, had 10 years or less in the teaching profession. However, all the teachers who participated in the study went through their teacher training after Zimbabwe's independence in 1980. From the data on teachers' experience, it does not appear that teaching experience was a factor considered in assigning the teachers to their class.

Teachers are the mediators and facilitators of knowledge, and implementers of educational policy. Therefore, their contributions were vital to this research process. I collected data on their experiences in teaching science, how they felt about using indigenous knowledge and languages in the teaching and learning of science in their classes. I also gathered data on techniques that they used when teaching science, and how they included community knowledge in their teaching. I was committed to collecting explanations from teachers on what it meant to them to be science teachers and their experiences in defining, interpreting and teaching science. What was important was to gather data that constituted stories from the teachers' experiences. From their stories I discovered and discerned what it meant to them to teach science using various perspectives, especially an indigenous perspective. Meaning making, understandings and interpretations were crucial to my study. This was in line with Bogdan and Biklen (1992) who suggest that meaning is of essential concern to qualitative research and interpretive inquiry.

Sampling procedure

The sampling procedure, for this study, followed the philosophical principles of qualitative inquiry. As Denzin and Lincoln (1994, p. 202) put it, "Many qualitative researchers employ…purposive, and not random, sampling methods. They seek out groups, settings and individuals where…the process being studied is most likely to occur." Ten primary school teachers from one rural school formed the cases for this study. The classes that these teachers taught ranged from Grade 4 to Grade 7, as shown in Table II below.

Table II

Teachers who participated in this study by gender and grade level

Grade	Male	Female	Total
Four	0	2	**2**
Five	1	2	**3**
Six	2	0	**2**
Seven	3	0	**3**
Total	**6**	**4**	**10**

These teachers were selected, not because of their gender or for constituting a representative sample, but because they were cases that were appropriate for this study since no deductive inferences were to emerge from the findings. The teachers also happened to be those teaching the classes that were targeted for this study. These were Grade 4 to Grade 7 classes, the classes that use English as a medium of instruction to teach science, as per the Education Act of 1987. They were purposefully selected or sampled from the school, which at the time had 18 teachers on staff. According to Arber (1993), cited in Silverman (2000, p.102), "The purpose of sampling is usually to study a representative subsection of a precisely defined population in order to make inferences about the whole population." Such sampling procedures are, however, usually unavailable in qualitative research. In qualitative studies thick in-depth data are often derived from one or more cases and it is unlikely that these cases will have been selected on a random basis. Wiersma (2000) also argues that probability- sampling procedures that include some form of random selection are not always appropriate or desirable in qualitative research.

Qualitative research, such as case studies, typically is not amenable to random sampling, at least for the site selection. Sampling should be based on the purpose of the research and the paradigm of the research. Thus *purposeful sampling* was utilized in this constructivist and interpretive study. Purposeful sampling is where "the researcher employs his/her own discretion to select the respondents who best meet the purposes of the study" (Neutens and Rubinson, 1997, p.125). This sampling technique, also advocated in Morse and Field (1995, p. 80), identifies *appropriateness* as a guiding principle in qualitative research. Appropriateness "is derived from the identification and use of the participants who can best inform the research according to the theoretical requirements of the study" (Morse & Field, 1995, p. 80). This procedure was favored among others because the aim of the study was neither to reach generalizations nor to test hypotheses and theories. Rather its concern was to explore, discover and describe specific experiences and situations of teachers in their classroom settings. Wiersma (2000) explains that qualitative research does not aim at arguing findings statistically, therefore, generalizability of the results is not of great importance when conducting interpretive case studies. While random sampling seeks a sample that is representative of the population, purposeful sampling seeks a sample of information-rich cases and studies it in depth (McMillan & Schumacher, 1997; Creswell, 1998; Wiersma, 2000).

Sample size

Although case studies have been praised for their life-like situations and holistic approach to studying social phenomena involving multiple variables, they also have met with considerable criticism. According to Tellis (1997), one frequent criticism is that their dependence on a single case renders them incapable of providing a generalizing conclusion since the cases in the sample lack representativeness because we cannot assume that they reflect the characteristics found in the wider population. Case study methodology is considered "microscopic" because it "lacks a sufficient number" of cases. However, Yin (1993, 1994) forcefully argues that the relative size of the sample, whether 2, 10 or 100 cases are used, does not transform a multiple case into a macroscopic study. The goal of case study is not to make generalizations but to establish insights, meanings and understandings of cases on a particular issue. Therefore, the goal of the study should establish the parameters. In this way even a single case could be considered acceptable, provided it met the established objective.

The parameters for the current study were therefore, to establish insights, meanings and understandings of teaching of science applied through indigenous perspectives by 10 primary school teachers in one rural primary school in Zimbabwe. It was concerned with the situation and context in which constructions and interpretations of indigenous knowledge and science are created. This study was concerned with meaning making rather making generalized conclusions.

The *sample size (n=10)* for this research might appear small but this is typical of qualitative studies. Wiersma (2000) asserts that sample size in qualitative research is typically small. What determines the sample size is the purpose of the study. In this study I was not aiming for representativeness and generalizability of the results. The purpose of the study was to get thick descriptions of teachers' experiences in using indigenous knowledge and languages in teaching science in their specific location. Lincoln and Guba (1985, p.202) make the following point about sample size:

> In purposeful sampling the size of the sample is determined by informational considerations. If the purpose is to maximize information, the sampling is terminated when no new information is forthcoming from new sample units; thus redundancy is the primary criterion.

Silverman (2000) warns that when utilizing purposeful sampling we must think critically about the parameters of the population we are interested in and choose our sample carefully on this basis.

Patton (1990) reveals that deciding on a sample size for qualitative inquiry can be even more difficult than quantitative because there are no definite rules to be followed. Selection will depend on what the researcher wants to know, the purpose of the inquiry, what is at stake, what will be useful and what can be done with available time and resources. McMillan and Schumacher (1997) also point out that insights generated from qualitative inquiry depend more on the information-richness of the cases and the analytical capabilities of the researcher than on the sample size. Teachers in the rural school, whom I observed teaching and interviewed, were more likely to be conscious and sensitive to the cultural backgrounds of their students than their urban school counterparts. They were also likely to be aware of the limitations of the English language as the medium of instruction in schools in Zimbabwe. English is likely to inhibit students' understanding and comprehension of scientific concepts. On the basis of these considerations, the 10 rural primary school teachers selected were most likely to provide "intense descriptions of the phenomenon under investigation and enough variation in the data to develop a comprehensive structural description" (Polkinhorne, 1995, p.11).

The sampling principle of *adequacy* (Morse and Field, 1995) was applied in this case. The shortage of fuel, financial constraint and the unstable political situation would not allow me to cover a wider geographical space as I had planned. However, the most vital factor determining the size of my sample (n=10) was the expectation that data deemed adequate and thick enough to develop a full and rich description of teachers' experiences in the teaching and learning of science using indigenous perspectives would be collected. McMillan and Schumacher (1997) note that the power and logic of purposeful sampling is that a few cases studied in depth yield many insights about the topic. To use Morse and Field's (1995, p.80) words, "...the stage of saturation" is likely to be reached through intense observations of a few cases. To reach this saturation stage, each of the 10 teachers was observed teaching two science lessons on any topic in the primary school science syllabus. Semi-structured interviews were conducted after these classroom observations to develop on some observed situations, which may have required further clarification. Interviews were conducted after classroom observations in order to avoid influencing teaching behavior during the observation stage.

Sampling criteria

Participants in this study were to be selected on the basis of the following criteria:

1. Participants had to be science teachers in a rural primary school in Zimbabwe.
2. Both male and female teachers were selected to participate in this study.
3. Only consenting teachers were eligible to participate in this study.
4. All participants were full-time and fully qualified primary school teachers holding a teacher's certificate obtained from a teacher's college in Zimbabwe, except in one case in which a student teacher had replaced a teacher who was ill. The student teacher was in the second year of teaching practice.
5. The participants were of varying teaching experience, ranging from 1 year

to 30 years or more. The assumption was that teaching experience and the period when the teachers were trained might have an influence on their pedagogical practices.

Gaining access and ethical issues

Gaining access to the research site and setting is very crucial to the research process. It involves decisions about who can be talked to, when and where, and how to obtain documents. Jansen and Davis (1998) warn that when researchers and participants differ in terms of social class, gender, ethnic background, beliefs or specific experiences, researchers should reflect on how these differences influence their ability to gain access. The research problem I investigated was topical with government and education policy makers. Soon after independence in 1980, the Ministry of Education and Culture in Zimbabwe initiated curriculum changes that included making indigenous knowledge present in schools. In addition, the previous 5-year national development plan in Zimbabwe states, "development of science and technology is Zimbabwe's long term and most important strategy for economic and social development" (Government of Zimbabwe, 1991, p.84). According to Shumba (1999), the scientific worldview assumed in these plans is not substantially congruent with the predominantly traditional worldviews in Zimbabwean culture, neither is it sufficiently widespread. In light of this observation, I was confident that education policy makers in the Ministry of Education and Culture would give me maximum support since they would view this study as an evaluation of how well teachers are integrating indigenous views in the teaching of science.

Curriculum innovation is one of the ministry's current pursuits, so it is because of this policy innovation that I felt the Ministry of Education and Culture in Zimbabwe would allow me to visit the school, the site of the research, to make classroom observations and interview teachers. Thus, after submitting my request to conduct the research in one rural primary school (See Appendix I), I had no problem in securing permission to visit the school. I was given a letter that indicated that I had been granted permission to carry out the study with teachers in that school (See Appendix II). The letter was obtained in June 2003 followed by an initial visit to the school to familiarize myself with the school environment and classroom settings as well as with the teachers and students. I used that letter to easily get access to the school where this study was conducted. I took the letter with me on the first day I went to introduce myself to the school head and teachers. On the same day, we had a meeting where I gave the head and teachers my letter of introduction (See Appendix III) and had to plan the observation and interview program with them.

At this meeting, which involved the school head, selected teachers (Grade 4 to Grade 7) and me, we discussed the purpose of my study, how the results were going to be used, how the study was to be conducted, and the contributions I expected from the teachers. Teachers were encouraged to ask questions and comment on the information that was given to them. I hoped that this revelation would not lead to reactivity, or observer effect later during the observation stage. Teachers who were willing to take part in the study were asked to complete and sign a form of consent (See Appendix IV). The teachers were also asked to distribute my introduction letters to their students (See Appendix V) and letters to the students' parents or guardians (See Appendix VII). In addition, they were also asked to distribute and collect on my behalf consent forms for students (See Appendix VI) and consent forms for parents/guardians (See Appendix VIII). The set of forms explained the purpose of my study and what I would do with the findings.

I also assured and guaranteed the teachers, students and parents/guardians confidentiality and anonymity. Bogdan and Biklen (1992) advise that subjects' identities should be protected so that the information that researchers collect does not embarrass or harm participants. I informed the teachers and parents of students that the participants' involvement in the study was voluntary and that they were not obliged to participate, if they were not willing to do so. I also informed them of their right to opt out of the study at any time during the course of the study. The relationship between the researcher and participants is very important to the success of the research process. So, only willing teachers were selected for the study. As Bogdan and Biklen (1992) state, the process of doing qualitative inquiry is an interplay between researchers and their subjects since researchers do not approach their subjects neutrally. Therefore, to enhance dialogue or conversation it was important that I initiated a frank and congenial climate from the start.

The topic and methodology were not too sensitive to be of any harm to both teachers and students. Participants' freedom to participate in the study was assured and I established rapport that was necessary to build a relationship of trust with them. A relationship based on trust and collegiality is vital for the success of any research process, thus the research process was conducted in an environment of genuine dialogue, willingness and openness.

Classroom observations

The observational method was employed to gather data in this interpretive case study. Observation is one of the primary and critical methods in qualitative inquiry (Neutens & Rubinson, 1997). Sarantakos (1998, p.207) defines observation as "a method of data collection that employs vision as its main means of data collection." Marshall and Rossman (1995, p.79) add, "Observation entails systematic noting and recording of events, behaviors, and artifacts in the social setting chosen for study." Wiersma (2000, p.248) describes it as "an ethnographic research [which] is comprehensive ...continuing and total." What is common to these definitions is the holistic nature of data collection that is employed through observational research. Silverman (2000) adds to the debate by warning that observers who fail to use their eyes as well as their ears are neglecting a crucial source of data. To capture the perspective of the individuals being observed, as well as their activities and behavior, requires careful listening and watching so as to pick up subtle clues and nuances.

In the present study, I conducted two unstructured non-participant observations with each of the ten teachers. All the teachers were teaching a science topic of their own choice. A pre-observation visit had been conducted earlier to each class before the final observation was made. During the pre-observation stage I used a video recorder to capture the classroom culture, classroom displays and students' reaction to being videotaped. This initial visit was a pre-test of both the teachers' and students' attitudes and reaction to my presence in their classrooms. Although teachers appeared comfortable and undisturbed by my presence, some students appeared distracted by this presence.

However, they appeared keen to have their pictures taken while learning. After spending more than one hour in each class, the students' reactions changed gradually to a near "normal" situation. Ten hours (5 hours per day) were spent in the classroom during the two days I visited the school for the purpose of gaining familiarization. The initial or pre-test visit proved very important to both the participants and me as we were able to establish the rapport and trust that is necessary in qualitative research that involves personal contact during observation and interview.

During the final phase of the research, a total of 20 classroom observations were carried out. Each observation was approximately one hour. This means that two hours were spent with each class, and 20 hours with all the ten classes. The method of observation was largely non-participant and unstructured. I did not take part in any class discussion in order to avoided influencing the classroom activities and interactions. As Fraenkel and Wallen (2003) note, in non-participant observation studies "the researcher does not participate in an activity or situation, but observes 'from the sidelines'." If the observation is unstructured, the observation is open to all observable phenomena, observing possibly everything without the use of checklists that categorize and focus on specific actions, behaviors and activities.

I attempted to carry out the observations as unobtrusively as possible to guard against what Drury and Stott (2001, p.52) describe as "reactivity." Reactivity refers to the change or "bias in the human condition" (Aguilar, 1981 cited in Drury and Stott, 2001, p.52) that the observer brings to the observation setting. When observing cases and events or activities within the research setting the observer attempts to record all relevant information in an *unobtrusive* and unstructured manner (Stake, 1995). The aim is to collect as much data as possible without interfering with the normal routine of classroom life. In my study I observed and recorded on tape, both video and audio, how the teacher and students communicated, their reactions to questions and answers, and the language that was used during instruction and discussions. I also observed and recorded the information that was written on the chalkboard, on the posters and written by students during group work.

Although I attempted, as possibly as I could, to be detached from the happenings in the classrooms and avoid influencing student and teacher behavior it was not possible to be completely *unobtrusive*. My presence in the classroom setting and the use of a video recorder tended to influence teachers and students to act in "artificial" ways. This reaction is what many researchers have described as "the observer effect" (Fraenkel & Wallen, 2003). However, employing videotaping was very helpful later in screening behavior that was considered artificial, since the camera tended to capture most of the activities taking place during the observation sessions. Although Fraenkel and Wallen (2003) argue that because of this *observer effect* many researchers feel that participants in a study should not be informed of the study's purpose until after the data have been collected, I could not implement this idea as I felt that it was unethical and bordered on deceiving participants. If I had done that, I would have possibly harmed my relationship with the participants, if they were later to discover the deception. Therefore, to minimize suspicion from participants and to facilitate cooperation I informed the teachers in this study that the purpose of my study was to find out how they taught science to their students.

Observing using a video recorder

As stated earlier on, to capture the events that were occurring in the classrooms, I observed these happenings using a video recorder. I had to arrive early for each lesson that I was to observe. This was meant to prepare the recording and to reduce anxiety and curiosity in students. One major advantage of using a video recorder is that the researcher can record what he/she can see and what he/she can hear (Silverman, 2000). If the observer were well positioned, most of the activities in the classroom would be easily captured. However, this was not possible in my case since the classes were big, with more than 50 students, and I had to look for positions that had sufficient light since the rooms had no electricity. The purpose of using a video recorder was to record what the teachers and students said and did in the classroom. The advantage of using a video, although it was somehow obtrusive, was that real actions were captured as they happened in their natural setting. One distinct advantage of videotaping classroom activities is that the video recorded actual behavior, not what people say they said/did or believe they will say/do (Fraenkel and Wallen, 2003).

In addition to observing behavior and recording what was said and done, I was also able to capture instructional aids that were in the classroom. These aids were not likely to be discovered through interviewing participants. Posters and artifacts that were on display had a story to tell on the subject matter of science that was being taught, including forms of indigenous knowledge and languages. For example, posters and three-dimensional learning aids were likely to reveal much more than what could have been revealed through interviews. Ideally, the aim was to capture everything that went on in the classroom. The use of the video made it possible to view the captured situations repeatedly during data analysis, thus obtaining more in-depth information. According to Morse and Field (1995, p.105), observations "...add breadth to research and provide answers to contextual questions that cannot be answered by interviews alone."

A disadvantage associated with the observation technique, even using a video recorder, is that the information gathered does not provide any insights into what the person may be thinking or what might motivate a given behavior or comment. In my study the interview was utilized to overcome this shortcoming. Following Stake's (1995, 2000) ideas, I found out that talking and asking people directly was useful in obtaining the required insights and filling the gap left out by observations. Therefore, in addition to utilizing observational method, I also conducted semi-structured interviews. The advantage of following up observations with interviews was that the teachers' observed and recorded behaviors could be compared to their statements to confirm, clarify and add breadth and depth to what had been observed during their teaching of science. Starting the study with interviews would have led teachers to engage in socially acceptable activities during their teaching, since the interviews were likely to have given away the themes of the study in detail.

Semi-structured interviews

In addition to classroom observations, I also utilized semi-structured interviews to obtain teachers' thinking, experiences and insights with respect to the teaching and learning of science in that primary school using indigenous perspectives. Interviews helped me make teachers clarify and confirm data collected using the observational method. The interviews were audio taped "to record naturally occurring interaction" (Silverman, 2000, p.43). I used semi-structured interviews for this study because of their open-ended style. An open-ended interview is like "extending an invitation to conversation" (Weber, 1986, p. 65). The interviews were a kind of dialogue with the teachers; the occasions were just like a friendly chat. Hence there was always a question to answer or a topic to discuss.

The interviewing applied minimum control over the teachers and their responses. Sarantakos (1998) says that in unstructured and semi-structured interviews there are no restrictions in the wording of the questions, the order of questions or the interview schedule. Therefore I had questions that guided and helped me to remain focused on the research questions and objectives as well as the purpose of the study (See Appendix IX). Morse and Richards (2002) point out that unstructured and semi-structured interviews are interactive and guided by relatively few questions that may be only one or more "grand tour" questions. In this context, I acted freely on the basis of certain research points, formulating questions as and when required in hermeneutic fashion. The structure of these interviews was flexible and the restrictions minimal, being presented in most cases in the form of guides rather than rules. What was important was for me to listen and learn from participants. My role as the researcher was to be an active listener and facilitator of the conversations, with the ability to fill up gaps and seek clarification using unplanned and unanticipated questions. Semi-structured interviews are amenable to conversation and this was vital to my study.

Conducting the interview

The setting of an interview is important to the process so that the interview may proceed uninterrupted. Sarantakos (1998) points out that the environment for the interview should be stimulating, comfortable and conducive to quiet, private and relaxed talk. The setting should be free enough to allow uninhibited interaction between the researcher and the participants. During the initial visit to the school where I did my research, the head (principal) allocated me a room where I could meet freely with the teachers for our conversations/interviews. Although the head had indicated that I was free to meet each teacher any time, I had to consult the teachers involved to determine the most suitable and appropriate time when we could have an unhurried talk without disturbance. I advised the participants on the flexibility of the interviews and that they were free to decide when to adjourn or to discontinue an interview for whatever reason. They were also assured that they were free to inform the researcher to delete or stop recording any statements they may not have wanted recorded. Their freedom of choice was fully honored. Interestingly, there were no participants who opted out, and none of them wanted statements deleted or left unrecorded.

I recorded the interviews using an audio tape recorder. At the same time, I also wrote working notes to ensure that the participants' perspectives were captured accurately (Bogdan & Biklen, 1992). The tape recording of interviews facilitated active listening, while working notes helped me keep track of what needed to be explored and raised later when the timing was right rather than interrupting the interviewees. The goal of this interpretive inquiry was to answer ***how*** and ***what*** questions in order to understand "social experience…organized, perceived, and constructed by individuals" (Denzin, 1989, p.24), in this case, by teachers. The *how* and *what* questions opened up forays into the topic and the research questions and uncovered the endemic and inescapable issues noted during classroom observations and within the topic at hand. The questions and issues I raised during the interviews were meant to illuminate their understanding of indigenous knowledge/science, how it is perceived and experienced and what it meant to teachers and students. *What* and *how* questions invited the inclusion of the phenomenon being studied, its context and its process.

According to Merriam (1988), an interpretive inquiry involves an understanding of the context and process of the research procedure. The context and process enhance and support the understanding of the inquiry by tapping the relationship between the personal and the social out of recognition that personal stories are embedded in social and institutional contexts (Laird, 1994). The experiences of teachers in this research were likely to be located within the personal, social and institutional contexts. Questions concerning how the institutional context affects the personal and social in teaching indigenous science were posed.

It is important to note that different forms of questions arise as a result of responses that emanate from the investigation (Morse, 1994). Thus the questions that were raised and that emerged as a result of our conversation to enhance understanding or comprehension emanated from adherence to several questioning techniques. The technique of active inquiry was adopted when participants were actively asked questions focusing on "When?" "Where?" and "Why?" Participants were also encouraged to tell their stories or narratives by introducing the conversation with "Tell me about __" or "What kinds of ___?" These questions helped to draw more information as generalities, vagueness and the significance of statements were clarified.

As Morse (1994, p.24) hints, "The investigator must act like a sponge, absorbing and drawing in information, maintaining a spirit of inquisitiveness, rather than a judgmental or evaluative manner." By using a variety of questioning techniques I was able to generate responses that opened and uncovered new information for further inquiry. I re-examined responses that emerged from the preceding set of deliberations and reframed questions to gather in-depth data and insights that might not have been obvious from the initial responses. Further inquiry usually revealed the unexpected and distinguished the usual from the exceptions. When the exception or unexpected was revealed there was always the need to further ask the "Why?" or "How come?" questions. As Yin (1994, p.56) points out, "an inquiring mind is a major prerequisite *during* data collection…." It is through such inquiry that important and thick descriptive data were collected. Because the specific information that may have become relevant to the study may not have been readily predictable, I was constantly alert of this and would ask why events appeared to have happened or to be happening that way.

Seidman (1991) suggests that interviewers should ask questions when they feel unsatisfied with what they have heard. Interpretive inquiry is about being able to interpret events and being able to make sense of the happenings and being able to ask good questions that eventually shed light on how and why events are as they appear. To ask good questions requires that a researcher listens more and talks less. Thus, in most cases I did more listening than talking. I made sure that the conversations did not go beyond the length of time (one and half-hours) agreed on for the interviews.

Study of documents

Documents are an important component of research. All teachers use one document of some form or another. These could be in the form of self-made documents or those provided by policy makers, publishers or other stakeholders who may be interested in providing educational resources to teachers. According to Creswell (1998), documents refer to all kinds of written records such as government policies, educational legislation and stipulation, educational plans, educational statistics, demographic trends, school reports, teaching plans, student health cards, examination records, school meeting minutes, classroom journals and so on. In this study, I used documents to supplement data obtained through observations and interviews. The documents I consulted included the *Government of Zimbabwe Education Act of 1987*, the *Primary School Environmental Science Syllabus,* science textbooks and wall posters. I perused these documents to ascertain detailed information on government's policy, aims and objectives in teaching science in primary schools in Zimbabwe. Textbooks were not used to determine the content of science but to discover and describe how teachers used them during the teaching process.

From documents I hoped to get data that would reveal the extent to which indigenous knowledge and languages were being used or may have been utilized before the commencement of this research. The type of documents I scrutinized was influenced by the research questions and the data I came across during lesson observations and while conducting interviews. Morse (1994) contends that data from available documentary resources often can address some of the research questions. Indeed, records and documents proved to be rich sources of qualitative data for my study.

Analysis of data

Constructivist-interpretive inquiry is based on the theoretical and methodological principles of doing qualitative research. As a result, it involves inductive analysis and is not dependent on quantitative measurement, standardization and statistical techniques. According to Morse (1994, p.25):

> Doing qualitative research is not a passive endeavor…data analysis is a process that requires astute questioning, a relentless search for answers, active observation, and accurate recall. It is a process of piecing together data, of making the invisible obvious, of linking seemingly unrelated facts logically, of fitting categories one with another, and of attributing consequences to antecedents.

Data analysis in interpretive research cannot be predetermined nor predicted. It emerges during the course of data collection. Analysis is not done after the researcher has ended the investigation. It is an ongoing process that commences from the day the researcher starts fieldwork. Continuous data analysis assists the researcher to make sense of the data gathered. As Morse (1994) and Ellis (1998b) state, ongoing analysis guides the researcher in employing the hermeneutic process of looping back and forward in order to determine gaps in coherence and comprehension as well as to check and correct first impressions. The researcher may need to resume data collection to fill the gaps discovered. In most cases, the process of interpretive inquiry brings together collection and analysis of data in such a way that identifying data leads automatically to their analysis. These, in turn, lead the researcher to the area in which new data should be sought and identified, in order to be analyzed again. Data collection, analysis and evaluation are one and the same process. However, Sarantakos (1998) advises that when the method of data collection is interviewing or participant observation, the during-collection analysis is rather limited. Data can only make sense after interviews are transcribed and listened to later, especially when more than one interviewer/observer is employed. Thus, for my research, data analysis was informed by these interpretive data analysis principles.

Data analysis involves analyzing transcripts of tapes recorded during fieldwork. It is about making sense of information and bringing order and meaning to the mass of collected data. It involves making connections, linking themes and ideas together. For my research, I used narrative analysis or conversational analysis and analysis of narratives (Polkinghorne, 1995). Open-ended interviews with teachers describing their experiences were amenable to both forms of analysis. I used narratives from interviews to construct a comprehensive and holistic understanding of teachers' experiences in teaching indigenous knowledge in primary school science curriculum in Zimbabwe. Narrative analysis resulted in teachers' narrative portraits. I also analyzed stories emanating from the interviews to discern patterns, commonalties, and insights that led to conclusions about science in the primary school curriculum. However, these conclusions were specific to the experiences of the teachers in the study; they were not representative of all primary school science teachers in Zimbabwe.

In analyzing the interview data, the cultural context in which the school is situated was taken into account. Ellis (1998b), Mishler (1986) and Polkinghorne (1995) stress the need for researchers to include descriptions of the cultural context in which the informants' experiences are situated. This means analyzing how cultural expectations such as values, language and meanings are framed and made sense of. Mishler (1986, p.244) points out that "cultural interpretations of stories, that is, an interpretation of ...frameworks of meaning, requires introduction of more general knowledge of the culture than is contained in the text itself." From this perspective I was able to analyze the teachers' portraits as cultural stories since they were likely to be embedded in their cultural settings. Science is a cultural construct and should be perceived in that context.

Language occupies a vital position in developing an understanding of interpretive data, especially the lived experiences of teachers in teaching science. It is important to be sensitive to the language the participants use. van Manen (1984, p.66) posits that "[analysis] consists of the ability, or rather the art, to be sensitive - sensitive to the subtle undertones of language, to the way language speaks when it allows the things themselves to speak." By gleaning the language used by the teachers during lesson observations and interviews I was able to establish what indigenous knowledge meant to them. I also attempted to determine through their language the participants' attitudes and feelings towards indigenous science. By analyzing language patterns such as word use, similes, idioms and metaphors I intended to capture the subjective meanings behind the language used. I did this by extracting *quotations* to analyze the language used by respondents. According to Carson (1986), the research stance [data analysis included] is one of allowing the meaning to emerge through the language. The tone of language used by the teachers while responding to students' contributions and during conversation with the researcher was also important as it permitted the researcher "to see the deeper significance, or meaning-structures, of the lived experience it describes" (van Manen, 1984, p.66). Tone reflected the mood, fears, struggles, insight and confidence the teachers had about the indigenous knowledge/science and Western science.

Closely related to language and cultural context is the *thematic approach*, which has developed from phenomenological research. van Manen (1984) argues that any lived-experience description is an appropriate source for uncovering thematic aspects of the phenomenon it describes. In isolating themes from interviews or texts the focus is on statements or phrases that reveal the nature of the experience being described. *Thematic analysis* "...involves the search for and identification of common threads that extend through an entire interview or set of interviews" (Morse & Field, 1995, p.139). It is embedded in grand theory and based on analysis of narratives or the paradigmatic approach (Polkinghorne, 1995). For instance, in my research on indigenous knowledge and science, I identified statements or phrases that revealed both the teachers' doubts about indigenous science and the challenges they faced in incorporating indigenous knowledge into teaching science.

The purpose of searching for themes was to highlight commonalities in the data that I had collected. Careful and thorough reading and re-reading of the transcribed unstructured interviews and reflection on them revealed emerging themes. Themes generated in the form of words, phrases and statements helped me construct stories on the topic. To arrive at my interpretation, I had to work inductively to actively construct meaning and develop insight by searching for patterns within the interviews and observations. Insights took the form of themes that made up the essential component of the final description that was crafted in this study.

The research credibility, transferability and dependability

To ensure credibility, transferability and dependability in qualitative inquiry is a formidable challenge. There is a general consensus that qualitative inquirers need to demonstrate that their studies are credible, transferable and dependable. *Credibility* refers to "...how accurately the account represents participants' realities of the social phenomena and is credible to them" (Schwandt, 1997, cited in Creswell & Miller, 2000, p.2). Mertens (1998), citing Guba and Lincoln (1989), states that credibility, as it pertains to the constructivist paradigm, parallels internal validity in postpositivist research. Credibility tests the correspondence between the ways the respondents actually perceive social constructs and the way the researcher portrays their viewpoints. To achieve this I had to spend prolonged and substantial engagement with teachers observing lessons and interviewing them. Persistent observation, which was long enough to identify salient issues, was conducted, hence, avoiding premature *closure*, coming to a conclusion about a situation without sufficient observation (Mertens, 1998). I spent prolonged time (two and half months, June to August) in the field to ensure that data collected (through interviews and observations) were saturated enough to establish stories, themes or categories, and analysis that evolved into a persuasive narrative.

Transferability is defined as "the degree to which you can generalize the results to other situations" (Mertens, 1998, p.68). Guba and Lincoln (1989) identify transferability as the qualitative parallel to external validity in postpositivist research. In qualitative inquiry, generalizations are not necessarily the expected outcomes. The burden of transferability is on the reader to determine the degree of similarity between the study site and the context of events being studied. This implies that in my research I had to provide sufficient detail to enable the reader to make such a judgment. The detail included description of the history of the research site, the context of the research and the culture of the community in which the site is located. In other words, I provided a "thick description" of the research process and outcome. A thick, rich description of research setting, and themes were necessary. Statements and quotations from participants and themes that emerged from the thick description are likely to assist the reader. The purpose of a thick description is that it creates verisimilitude, statements that produce for the readers the feeling that they have experienced, or could experience, the events being described in the study (Denzin, 1989).

Dependability is described in Guba and Lincoln (1994) as being parallel to reliability in the postpositivist paradigm. In the postpositivist paradigm it means stability over time. In the constructivist paradigm, change is expected since human behavior cannot be predicted and controlled. What is important in case studies is to keep track of the changes that occur during data collection. Yin (1994) calls this process, "maintaining a case study protocol." It describes in detail each step of the research process.

Credibility, transferability and dependability of data are subjective elements in qualitative inquiry. Qualitative findings are not outcomes that are based on getting agreement from participants; they are, in fact, the researcher's interpretations. They are the researcher's creation or discovery of patterns and insights. The problem in case studies is to establish meaning and understanding rather than truthfulness and accuracy, which are subjective. The patterns I found within participants' responses may not be discernible or comprehensible to them. Another point to be considered is that, since it is possible that the teachers in my study may not even agree one day with what they said during this study, I did not escape responsibility for my interpretations by resorting to them for confirmation. During analysis, I read and re-read the data to see if the constructs, categories, explanations, and interpretations made sense and answered the research questions. Altheide and Johnson (1994, p. 489) call this process "reflexive-accounting" where researchers and the sense-making process interact.

Finally, the interpretive tradition emphasizes that there is no detached, privileged standpoint from which one objectively records reality. Therefore, I am aware that my fore-structure or pre-understanding was likely to affect how I interacted with participants and how I was likely to be predisposed to looking for certain aspects and away from others. It is not possible for a researcher to completely detach her/himself from pre-understandings. These will always influence the researcher's accounts. The influence of pre-understanding or fore-structure is unavoidable since it is a result of shared social and cultural practices (Addison, 1989). My teaching background in Zimbabwean primary schools and familiarity with cultural practices of the country, as well as my personal beliefs and ideology in Western schooling and science are my fore-structure that might have influenced interpretations and meanings discerned from this study.

Angen (2000) reports that interpretations are temporal, located, and therefore always open to reinterpretations and the truth of an interpretation must continually be negotiated through continuous conversation or dialogue. Reinterpretation was helpful in overcoming the influence of my fore-structure since Addison (1989) comments that interpretations and meanings are not fixed or pre-established. Meaning or significance emerges and changes over time. They are open to reinterpretation. I hope that in hermeneutic circular fashion, as I learned about teachers' experiences I also learned about the way I am predisposed to perceiving and making sense of their classroom world as teachers of indigenous science.

Summary

In this chapter, I have described the constructivist-interpretive approach as the paradigm of this research. Since data that were collected are based on the subjective experiences of the teachers who are the cases in the case study, the constructivist paradigm was deemed the most suitable for the study. I also described the sampling procedure, the methods used to collect data, and the ethical issues related to the study. The next chapter will present findings from this qualitative inquiry. The findings were presented using the principles and guidelines of qualitative research methods, focusing on classroom interactions, the language used, themes and teaching strategies. Data were categorized into emerging themes and patterns as I attempted to give meaning and understanding to teachers' experiences and insights.

CHAPTER V

FINDINGS, INTERPRETATIONS AND DISCUSSIONS

Introduction

This constructivist-interpretive study is embedded in theoretical and methodological tenets of qualitative research. Thus, the method used to interpret the findings involves inductive analysis and is not dependent on quantitative standardization of data or inferential statistics. Data analysis and interpretation started on my first visit to the school when I came face-to-face with the social and cultural context and setting in which the case for study was located. The social and cultural setting was vital to my understanding of the cultural context in which the teachers and students interacted during the teaching and learning of science. Early analysis and interpretation was also conducted during class observations when I encountered events and occurrences that needed my immediate attention. In addition to this initial analysis and interpretation, I had also to decipher and discern meaning from the teachers' reactions to questions I raised during our conversations as well as from their reactions to students' contributions during their interactions in science lessons. I had to interpret or give meaning to the body language that was used, such as facial expressions, gestures, the tone of the voice and the verbal responses given to students' answers to questions.

Although the during-collection data analysis was vital to the study, as Sarantakos (1998) noted, it was rather limited to critical events and utterances that occurred during class observations. More insights were revealed after going over the videotapes several times and after the interviews were listened to and transcribed. However, continuous analysis from the day I arrived at the school assisted me to make sense of the natural setting of the school in which the teachers and students operated. Morse's (1994) advice on employing the hermeneutic process guided me during the initial and subsequent continuous analysis. Using this procedure, I was able to loop back and forward to determine gaps in coherence and comprehension as well as to check and correct first impressions I had created. This process was most effective when I conducted conversational interviews after class observations.

Data collected for this study are presented as findings in terms of themes and patterns that emerged after the interviews were transcribed. The data were collected from the contextual texts and narratives from the dialogue I had with teachers. They are also a result of the 20 class observations I made while the teachers were teaching science. These results include narrative quotations taken from discussions with teachers, and observations I recorded during class visits. Some of the results and interpretations are findings that emerged from inspection of the science syllabus and classroom artifacts. The data are analysed and categorized on the basis of similarities and differences in terms of how teachers perceive science and indigenous knowledge. In my discussion of the findings I have attempted to explain submissions and omissions from the teachers' narratives. It is also important to point out that what is presented in this chapter, as data, are the actual words of the teachers who were participants in this study. Their responses to questions that were raised in the conversational interviews are included verbatim without any editing. However, in instances where I felt that serious language errors existed, I added my own words or explanations in parenthesis. Some data that were collected from the syllabus and classroom artifacts are presented in tables and charts.

The historical, social and cultural setting of the school

The school where I conducted my case study is in a rural community, about 55 kilometres from Harare, the capital city of Zimbabwe. The school was built in 1924 as a community non-governmental church school. It started with four classes only, Sub A to Standard 2 (Grade 1 to Grade 4), and was administered by the Methodist Church (UK). The school has since expanded to 18 classes, encompassing Grade 1 to Grade 7. There are three streams for Grade 1, 2, 5 and 7 whereas Grades 3, 4 and 6 each has two streams. The streams are not decided on the ability or academic performance of students. There are 19 teachers, including the head teacher, who are all fully trained and accredited with the Ministry of Education, Sport and Culture. During the time I conducted this case study there were 12 female teachers and 7 male teachers. Every year the school receives student teachers, for teaching practice, from a nearby teachers' college. When I conducted data collection, from June to August, there were 10 student teachers on a two-year practice teaching assignment. The student teachers are attached to different classroom teachers who act as their mentors.

The governance of the school has changed hands over the years. During the colonial years church-administered primary schools in rural areas were handed over to Rural District Councils, which were given financial responsibility over the schools, while the parents were made responsible for the construction and development of the infrastructure. This organizational structure remained in place until 1992, when full authority to run schools was handed over to parents. In urban government schools, the School Development Association (SDA) controls the school, while in rural areas the School Development Committee (SDC) is responsible for the school. In both cases, the parents of students attending the school are the members of these associations or committees. However, the professional accountability of teachers and their salaries is the responsibility of the Government of Zimbabwe through the Ministry of Education, Sport and Culture. The school, which was the research site for my case study, is run by the SDC. The SDC is responsible for constructing classrooms and toilets, and fundraising.

The parents of students attending the school where I did my study were members of the low-income group in Zimbabwe and mainly peasants. The school head (principal) said this about the parents of learners in the school:

> *Their parents are mainly subsistence farmers. The soil is very poor, so they don't grow much. There are some who keep **mombes** [cattle] and **mbudzi** [goats], and these parents think that this [the schoolyard] is their ground for their animals. Some parents are also gardeners. They grow vegetables and sell that to look after their children and to send them to school.*

The rural setting of the school likely influences, to some extent, the culture of the school, the uniforms, the language used by learners, parental involvement, the behaviour of students and their learning styles and patterns. It is also likely to affect the communication patterns between parents, students and teachers and how teachers perceived the cultural knowledge that the learners brought to school. Perhaps, too, the social and cultural setting of the school influences teachers' understanding of the importance and relevance of culture in teaching school sciences. And the cultural beliefs of the community likely help determine the teachers' teaching approaches to science, as well as influence their attitude towards indigenous knowledge. The culture of the community - its beliefs, values, norms and traditions – may also be of significance to how students conceptualized school science. After all, since the majority of teachers lived at the school, they were most likely, to some extent, to be influenced by what happened in the community. However, when I asked the school head about whether traditions and beliefs of parents in the community surrounding the school were likely to affect students' learning styles in science, he replied that he did not believe the community followed any cultural beliefs to speak of. As he put it:

> *Ahhh ... traditional beliefs are out! The community is not far from Harare. They are actually Western, although they try to do a bit of their tradition. I have visited some of them, you know. When someone dies I get there. Sometimes they brew beer for **mabira** [traditional ceremonies to engage in dialogue with ancestral spirits]. Do you know **mabira**? I used to go to those and I found that they do not perform them the way we do it in deep Wedza (a rural community where the head comes from). Well they have the thread but the practice is not that accurate now. From my discovery, they are not doing it well [referring to traditional ceremonies]. There is a lot of Western infiltration. Western culture has come in too much. So I don't think their culture can influence how our students learn science. Science is Western culture.*

The head teacher seemed to have a general feeling that because of Westernization the local people had discarded their indigenous culture in pursuit of Western "civilization." His argument was also based on the assumption that early missionaries had had a strong impact on the community, since it was the missionaries who established the school. In addition, the school and a Methodist Church were within the same fence. As the head confidently stated, there was cooperation between the two institutions, which meant they influenced each other:

> *When I came here I revamped the relationship between the school and the church as you can see. If you look at that picture there [on the chart on the wall], you can see the Methodist Church Women [in their red blouses, black skirts and white hats]. You see [before I came] there was not much happening. Now I have had a lot of coordination. Before [I came here], do you see that church building? There*

> *was a fence between the school and the church. So I said no let's destroy that one. They [church members] can use benches, on all Sundays. They can take the benches into the church and we take the benches back. For instance, they are having a big convention during the holidays and I am organizing that one for them. They are working quite well with us.*

Although, historically, the church has been known to work against the cultural beliefs of indigenous people, it would appear that its approach has changed and is accommodating them in its religious practices. So the extent to which the church negatively influences the cultural teaching and practices of local people in post-independent Zimbabwe is a question for further research. The head teacher's assumption that cultural beliefs were not likely to have any impact on the science learning styles of students because of the church's influence or Westernization is contentious and contestable. Even members of different churches are known to harbour cultural beliefs and traditions, and are known to perform cultural rituals that the church was traditionally and historically against. The community-church relationship may not have any impact on how students learn science, but what they hear from their parents and elders and what they see being practiced in their communities may have an impact. An understanding of life experiences, be it scientific, spiritual or social, comes from the cultural environment in which the child is socialized.

Commenting on the nature of parental participation in the school, the school head indicated that parents were most welcome to participate in the school, but their roles were to be limited to membership on the School Development Committee and the responsibility for supplying students with school materials. During our discussion on parental and community involvement in the teaching and learning of science the school head laughed and said:

> *Haa ... not very much in that sense. We do not have meetings where we encourage them to contribute to teaching. But if you tell them that we need help in the teaching process, not much will be done from the parent's point of view. But I think the problem is ours, we are not involving them. Maybe, if we ask them, they may be willing to come. They are quite cooperative because I have had some time when I called parents of Grade 1 pupils for a meeting to discuss the needs of their children. Some of them are buying books for their children. And of recent, we have changed our Building Fund. We used to ask them to pay Zw$160 per term per child, now they are paying Zw$800 per child per term.*

Although the school head blamed the school for not encouraging parents to get involved in the formal teaching and learning of their children, there seemed to be a belief that parental involvement should not go beyond providing the material needs of the learners. Probably, the head's assumption that indigenous culture is not affecting the students in the learning of school science contributes to the marginalization of parents and their exclusion from the rewarding experiences of being cooperators and participants in their children's learning of science.

Analysis and discussion of the primary school science syllabus

The teaching of science in primary schools in Zimbabwe is guided by the *Primary School Environmental Science Syllabus,* which was published by the Curriculum Development Unit (1994). The document sets out the aims and objectives of science education in primary school, and also suggests learning activities and learning materials needed to achieve these objectives. In its preamble the document states:

> 1. *Environmental Science (ES) for Primary School is an integrated subject, which seeks to make pupils aware of themselves and the physical environment around them. Environmental Science provides opportunities for pupils to investigate such problems as drought, deforestation, air and water pollution and wildlife depletion whilst also developing process skills and concepts in science.*
>
> 2. *Environmental Science is the pupils' first formal experience of science. Its main purpose is to develop some basic scientific knowledge, skills and attitudes and provide opportunities to explore the world through simple scientific enquiry.*
>
> 3. *It is expected that pupils will be provided with opportunities to develop the ability to ask questions from a scientific point of view and begin to make their own decisions about how to undertake simple investigations and interpret the results.*

Pupils should, therefore, be able to apply acquired knowledge and skills in real life situations.

4. *It is important that pupils be provided with activities, which develop a basic understanding of environmental issues and for them to develop positive attitudes towards the environment.*

While the preamble gives details on what students are supposed to experience in science, it does not explicitly comment on the relationship between children's own family or community science knowledge and the new science they will meet in the classroom. Neither does it seem to treat science as a multicultural subject nor guide teachers on ways of adopting and incorporating cultural perspectives in teaching the subject. Although the syllabus states the importance of making pupils able "to apply acquired knowledge and skills in *real life situations,*" it is not certain whether teachers, with their educational backgrounds, such as colonial schooling and teacher training, are sharply aware that their "real life situations" and those of learners differ. The teachers' and students' different social and cultural backgrounds affect their perceptions and sensitivity to school science, which should accommodate these diverse cultural lives. The syllabus clearly places emphasis on the "scientific knowledge," skills and attitudes that learners will acquire through learning school science. The syllabus does not state in any way that the school science to be learned by primary school pupils in Zimbabwe is "Western." But the preamble strongly suggests that the "scientific knowledge" and skills that learners are expected to acquire are grounded in Western science.

The statements of purpose, in the syllabus, relate entirely to the learners' "formal experience of science" but it is undoubtedly silent on the informal experiences that should be the basis for learning school science. Informal experiences, which are unquestionably related to the indigenous knowledge and experiences learners bring to the classroom, cannot be ignored or disregarded. Experiences that students bring from their homes and communities are the bedrock on which students are likely to develop process skills and concepts in science. A process-based approach in science, which is one of the purposes of the primary school science in Zimbabwe, is easily developed and applied in everyday situations if school science starts from what students know, the indigenous knowledge from home. Incorporating indigenous knowledge or science brings school science closer to home, and ultimately science knowledge becomes meaningful knowledge that can be used to improve the quality of lives for members of the local community.

The aims for teaching science in primary schools in Zimbabwe are intended to develop skills and ways of thinking that have a mainly empirical basis. The connection between this empirical approach and the actual experiences and ways of solving problems used by rural communities is not clearly articulated. While the science is intended primarily, to be applied in everyday situations, the aims are silent on cultural ways of knowing and explaining phenomena. This omission raises the question of whether primary school science in Zimbabwe is taught using an inclusive and multicultural approach. The absence of a cultural approach to teaching science is likely to slow and retard students' understanding of scientific processes that the syllabus requires teachers to impart to their learners. According to the aims stated in the syllabus, pupils will:

- *acquire and develop manipulative and communicative skills.*
- *develop an awareness of the scientific relationship between people and the environment.*
- *use scientific knowledge and skills to influence and manage the environment.*
- *develop an awareness of the usefulness of science in the environment.*
- *develop creativity and inventiveness in scientific learning and interaction with the environment.*
- *develop positive attitudes to science-learning, science and technology.*
- *develop an enquiring mind and the ability to solve problems.*

The above aims strongly imply that when students come to school they do not have enquiring minds, inventiveness in scientific learning, or manipulative and communicative skills, and that they are unable to use scientific knowledge and skills. These assumptions run contrary to what happens in real life situations, especially in rural area where people are in everyday contact with the physical environment from which they derive their livelihood. Through the use of community knowledge, rural students grow up practicing various scientific skills and putting scientific knowledge into practice. They engage science in food production and storage, when they carry and balance heavy loads on their heads, when they use weather patterns and signs to make plans for their everyday work and when they use local herbs for both their health problems and those of their livestock. Scientific knowledge and skills are not experienced and developed in classrooms but through practical activities. Schools continue with what is learned at home and in the community by formalizing their scientific knowledge. What schools do primarily is link indigenous knowledge and science to the wider "universal" body of science and "Western" mode of thinking and knowing that schools teach. It is this link and connection between the two worlds of science that seems to be overlooked by the primary school science aims of teaching science.

An analysis of the objectives of teaching science in primary schools shows a link between the social and physical environment. Although the scientific method of studying science is maintained throughout, the social significance of teaching science is included in some of the following objectives, which state that pupils will:

- *identify natural resources;*
- *identify cycles and systems illustrating the relationship between people and natural resources;*
- *investigate how people influence and are influenced by science and technology;*
- *conserve, manage and sustain the natural environment for the survival and development of its elements;*
- *demonstrate an understanding of basic scientific concepts and principles;*
- *apply scientific concepts and skills to improve and manage the environment;*
- *use the local materials to design and modify simple technological devices;*
- *apply elements of primary health care in order to improve personal, family and community health.*

What seems to be apparent from all the sections of this syllabus is that scientific knowledge and ways of thinking deemed appropriate to school science are those that lie outside the experience of the learner. Students are perceived as empty vessels or *tabula rasa,* waiting for teachers to fill them with appropriate scientific skills and scientific learning styles. Students have to develop these attributes to be deemed to have acquired the scientific attitudes necessary for implementation in their everyday life situations. The syllabus appears to have been developed using a Euro-centric approach to the teaching of science rather than from a multi-knowledge or multi-science approach. A multi-science approach integrates sciences or incorporates the formerly neglected sciences into the teaching and learning of science in schools. The problem with a syllabus that contains prescribed knowledge and ways of making sense of the child's world is that it is likely to ignore the child's ways of knowing into which the child was socialized. Science teaching that does not include different perspectives and ways of viewing social and physical reality leads to teaching that is blinkered and unilogical. Teachers who are not trained to use multi-perspectives to teach science tend to follow strictly what the syllabus prescribes. If it is silent on indigenous science, the teachers will adopt a similar approach in their teaching.

Analysis and discussion of video observations

My twenty classroom visits and video-recorded observations of classroom activities during science lessons yielded the following findings which are presented in four main themes: teacher-student interaction, teaching approaches, the language employed to teach science, and teaching/learning aids used in the science lessons.

Teacher-student interactions during science lessons

The classroom relationship between the teachers and students in the ten classes I visited and observed were based on the teachers' power to determine what scientific knowledge was and how it was mediated to students. The teachers had the power and privilege to "construct" or rather to identify from textbooks and the syllabus what was deemed to be important knowledge. The teachers also defined and determined how the lessons were to be taught and how students were supposed to respond to the information taught. The students appeared to play a subordinate and receptive role. The asymmetrical relations of power that structured teacher-student relations were clearly observed in how one Grade 6 teacher interacted with his class while teaching a culturally sensitive lesson on *Reproduction*. For example, the teacher had to be careful about the extent to which he discussed sexuality with students. It is a taboo in African cultures to show the organs or to explicitly discuss topics on sex and sexuality. When the teacher showed a chart depicting sexual organs some students were observed giggling, while others were reluctant to name and point to the sexual organs drawn on the chart. The teacher exercised his power and authority by reminding the students the importance of the topic. His response to the students' reaction was:

> *This information is in your syllabus and textbooks. If you are shy to talk about it, what are you going to do when the examinations come? You will fail, so feel free to talk about these things.* ***Hameno henyu kana muchinyara.*** *(It is your problem, if you are shy).*

This is one problem that both teachers and students face when they have to discuss topics that are culturally sensitive. The teacher still had to define what was to be taught and how it was to be taught. Students did not have control over the selection of the learning material and how it was to be presented. The teacher had to teach the information as provided in the syllabus, while students reluctantly cooperated in the learning process. Should cultural taboos restrict teaching what the syllabus prescribes? Sensitivity does not mean avoiding teaching topics that are likely to offend students, but finding ways of making adjustments that accommodate students' cultural backgrounds. As observed with this Grade 6 teacher, there was no dialogue initiated to gradually make students feel comfortable and empowered to discuss the sensitive material in the lesson.

It would appear that teachers, in their quest to fulfil the demands of the syllabus, lack passion and compassion for their students. Sometimes students were observed to be showing hopelessness and despair in attempting to communicate their ideas to the class. However, instead of assisting students break the wall of despair some teachers appeared to enlarge the barriers of communication. For example, one Grade 7 student was struggling to describe what he had done in an activity to demonstrate that materials can change shape, form and size because he could not express himself fluently in English. When the student paused for a long time, struggling to get the words to use the teacher uttered, "*Stuck.*" The student thought that the teacher was helping him with the word to complete his sentence, so he repeated the word, and the teacher retorted:

> *"No, I mean you are stuck, you can't find the right word to use."*

At this, some students and the teacher laughed and the student did not take it well. After that he did not want to contribute any further to the lesson. The teacher failed to sympathize and empathize with the student. The attitude of the teachers and other students towards those who used Shona in class caused resentment and self-pity that imprisoned students in their silence.

Teaching techniques used in teaching science

The ten teachers in this study used teaching techniques that included primarily interrogative method (question and answer sessions) and experimentation, and one teacher used story-telling as a teaching method. The methods employed by the teachers were intended mainly to elicit "facts" or to prove information as "scientific fact."

Interrogative method

While listening and observing teaching in the 20 sessions I attended, it was apparent that the activities that were carried out by the students were programmed and preplanned. Teachers had sets of questions that they had prepared in advance and these were the questions they focused on. As noted earlier, most of the interaction that took place between the teachers and students was asymmetrical. Teachers asked questions while students provided answers or teachers gave instructions and students responded to them. The following transcript shows what went on in one Grade 7 class on a lesson on "Materials Change:"

Teacher: *What does water change into when we boil it?*

Student 1: *Into water vapour.*

Teacher: *Yes, what does wood change into when we burn it?*

Student 2: *Into ashes.*

Teacher: *Ehe, what does sugar change to when we put it in water?*

Student 3: *Into a solution.*

Teacher: *What did we do last time when we went outside the classroom?*

Student 4: *We burnt grass to ashes and broke some stones.*

Teacher: *Ehe, what else?*

Student 5: *We broke glasses and sticks to pieces.*

Teacher: *Yes, you were observing the changes, what kind of changes took place?*

Student 6: *The change was in form, shape and size.*

This kind of interaction between the teacher and students was typical of all the lessons I observed. Students' everyday experiences, home and community experiences, which could have been brought into the learning of science, were rarely made reference to. Teaching and learning was not conducted within the social context that students were familiar with. The teachers did not create situations where students were encouraged to "tell their stories." The voice that dominated the classroom was that of the teacher who was selecting from the textbook what was considered to be the appropriate science knowledge and facts to be learned. In none of the science lessons were students invited to tell their stories, which is the essence for moving from silence to speech and multi-knowledge discourse. Students appeared voiceless and the teachers defined and interpreted what the students were intended to grasp.

Although the teachers seemed to encourage students to talk during the lessons and group discussions, the talking was limited to leading questions they gave. Most of the questions did not reflect knowledge pluralism or hybridity but focused rather on the "scientific facts" selected from the syllabus and textbook. In one Grade 5 science lesson, for example, students were given a list of questions to answer in their groups. The aim of the group work was for students to come up with the correct answers selected from the chunk of information given to them. The following questions were listed on the chalkboard for the students:

1. *What did you find in the curved mirror or flat mirror?*
2. *What is the surface of a good reflector like?*
3. *An – curved mirror makes you look bigger.*
4. *What kind of a mirror would make you look smaller?*
5. *– reflective surfaces change size of an image.*
6. *What happens when you look yourself in a mirror?*

In a Grade 6 class, which was learning about *Trees and Forests (Respiration)*, students were asked to discuss in their groups the following questions that were in their textbook:

1. *What gas do plants use when they make plant food?*
2. *What gas do plants produce during photosynthesis?*
3. *What gas do the plants use when they respire?*
4. *What gas do plants produce when they respire?*
5. *What gas do people and other animals use when they respire?*
6. *What gas do people and other animals produce when they respire?*
7. *Plants, people and other animals, can use and produce which gases during different processes?*
8. *Plants and animals respire all the time. When does photosynthesis not take place?*

(Herberden, 1987, pp. 20-28).

As can be concluded from the questions above, the purpose of questioning was to solicit specific information that was regarded as factual. The questions themselves were repetitive and monotonous, and did not stimulate the learners to talk about their everyday experiences. The questions did not provide spaces for students to talk about their communities and activities that occur around them. Questions that are derived from stories that students personally identify with are likely to have more impact on them and likely to contribute towards meaning making and understanding than questions that are designed for memorization of information. For example, stories that include students' daily lives, such as *running to school, running after goats or cattle,* and *competing in athletics,* are stories on which questions on *Respiration* could have been based. The missing link between students' everyday lives and questioning techniques leads students to learn science through abstractions rather than through concrete lived experiences. The practice of giving students lists of questions to discuss in their groups was observed in most classes. What were missing were questions that linked science to its socio-cultural base. Cultural science that forms the base for social-scientific knowledge could not be easily identified from the questions that were given to students. The questioning styles were devoid of the scientific cultural dynamics that were relevant to the understanding of science in rural schools. The learning space lacked what Freire and Faundez (1989) refer to as critical learning and critical consciousness that is necessary for social change. Critical learning is important in challenging constructs that are found in current school science in Zimbabwe. It also questions the unchallenged voices of the teacher and textbook author whose texts are taken for granted and judged to be the absolute truth.

Experimentation as a science teaching technique

"Modern" science is associated with systematically planned and executed tests and controls. Through tests or experiments "scientific tests" can be proved, accepted or refuted. Because science is perceived as a body of factual knowledge that is logical and amenable to experimentation, all ten teachers at one point or another in their lessons, had to carry out experiments with their students. I had earlier observed two Grade 7 teachers teaching lessons on “Materials Change.” One class boiled water to see water changing to vapour, while another made a fire to prove that wood burns to charcoal and ash. One Grade 6 class went out to collect objects the students were to change form, shape or size. Some students crushed stones, while others tore or crumbled papers. It is this idea of experimentation to verify theories that led some teachers, in my interviews, to discount indigenous knowledge as science or as relevant knowledge to be incorporated in school science. For these teachers, there appeared to be a “cultural knowledge gap” between what they perceived to be school science and traditional science or knowledge. The teachers appeared to make value judgments by classifying indigenous knowledge as superstition which is inconsistent with “modern” scientific reality.

Judging from what I observed in their teaching, "modern" scientific reality is observable, explicitly defined, and legitimated by empirical evidence. This also came out from the teachers forcefully during our conversation or interview.

Story-telling/community knowledge as a science teaching method

Story-telling can be a very effective method for teaching science since it captures students' attention and is a familiar teaching genre in African societies. In rural Zimbabwe, story-telling is used by grandparents and parents as an entertaining as well as teaching technique. Thus, when used in schools, story-telling can be effectively utilized to make students relate science to their everyday experiences and socio-cultural world. Although a few teachers expressed positive sentiments about indigenous knowledge and school science, not all of them had incorporated cultural teaching techniques in lessons that I had observed them teach. In some classes, I struggled to identify the indigenous knowledge that was incorporated. However, in one Grade 5 class I listened with interest as the teacher used a *traditional folktale* on "The Greed Dog" to teach a lesson on "reflection." The dog dropped a bone into the pond of water when it saw its reflection in the water and thought it was another dog, and was so greedy that it wanted to snatch "the bone" from "the other dog." This kind of scientific knowledge was already part and parcel of children's cultural knowledge. What was not apparent to children was the "light and reflection" scientific explanation the teacher clarified for them. There are many folktales, which teach the concept "reflection". The teacher could have asked learners to tell "their stories" on this concept, including a popular folktale about a woman who saw her reflection in a mirror for the first time and beat her husband who had come from town accusing him of hiding another woman in the suitcase he had brought home. In recent years (2001 and 2002) there have been eclipses of the moon in Zimbabwe, of which all children were likely to be aware. The teacher could have used these to explain the reflection of light using both a cultural perspective on ***kuora kwezuva*** [the rotting of the sun] and the Western scientific explanation. These examples could have helped students to understand the scientific concept and phenomenon from multiple perspectives in order to cross cultural borders of science smoothly.

Every society practices science, which is culturally determined by the social and cultural experiences of the members of that community. In one Grade 7 class, I noted that the teacher used the knowledge that learners knew from home to explain changes that result from applying heat to objects. During the course of the lesson the teacher had this to say to the students:

> *At our rural homes we have pots that are used for cooking and storing water. Do you know them? What material is used to make them?*

Students responded by stating that the pots were made of *clay*. When he asked for those that knew *clay pots* and had them at home, the entire class raised its hands. The teacher then asked,

> *What are the changes that take place when making these pots and how do we make them strong? Before you tell me the answer, list the changes in your groups. Later select someone from your group to explain to us the changes. Now do it in your groups.*

Later two boys and three girls were selected to explain how pots and clay models used as toys were molded and "fired" in a furnace to make them strong. Most students knew about this because in rural Zimbabwe, most families use clay pots to prepare their meals in, and it is possible that some students had seen their parents or grandparents making these pots. And this knowledge on clay pots is indigenous to women in rural areas in Zimbabwe and girls are taught at an early age in their teens to learn making these pots. They know the texture required for the pots to be strong and the right temperature level when firing the pots. Indigenous knowledge is expressed and used by both males and females, although in some cases each gender has specialized knowledge attributed to it. The teacher appropriately used the children's cultural knowledge to enhance their understanding of the scientific concepts they were supposed to learn on the topic of *Materials Change*.

Silencing voices: the language of frustration

Some teachers were observed enforcing the use of English-only discourse in their science lessons. The teachers were observed discouraging students from responding to questions in their mother language. In some instances the teachers responded by mocking students who used an indigenous language in the lesson. In one such example, a teacher who was teaching a Grade 5 class about "houseflies" had the following exchange with students:

Teacher: *What do [house] flies feed on?*
Student 1: *Sadza [a staple food in Zimbabwe].*
Teacher: *Ehe! What else?*
Student 2: *Faeces [human waste].*
Teacher: *Ehe!*
Student 3: *Ndove [cow dung].*
Teacher: *[With a mocking voice]: Shall I have to write **ndove** on the board?*

The tone of the teacher's voice and question made other students laugh and the teacher repeated the question with the same tone of voice:

> *Shall I have to write that on the board? A Grade 1 child should say that. If a Grade 5 child can say that, what then should a Grade 1 child say? Say it in English.*

The teacher was not sensitive to the language problems that the student was facing, and displayed an attitude that made those who were not able to express themselves in English reluctant to participate in the lesson. The importance attached to language in communicating ideas and sustaining conversation cannot be overemphasized. Language is a tool and vehicle for self-expression and exchanging information. Language can either expedite or frustrate social interaction in the learning process. The use of English as a medium of science instruction seems to frustrate some rural primary school students. Some teachers feel that science is best taught in English and students should be made to use the language in communicating ideas in class. Teachers who enforce the use of English-only discourse in their classrooms and discourage the use of indigenous languages and local beliefs that are brought to the classroom are engaging in "verbal repression." They repress and push students into becoming unwilling and non-participatory students. Students who are not competent in English and are denied the opportunity to use their indigenous languages are discriminated against. In the end, the hostile classroom environment, which lacks compassion, care and love, silences the learners. Usually the students become reluctant participants in class discussions and withdraw from interaction with the teacher. In so doing, they withhold information that may be vital to their understanding of science in the class. The language that the teacher demands students to use can therefore become a barrier to self-expression and rewarding learning experiences.

While I was observing a Grade 7 class going through a lesson on "Map Reading: Lines of Longitude and Latitude," the teacher conducted the entire lesson in English. Although the students appeared very attentive, when the teacher asked questions, very few of them responded. The problem seemed to arise from the teacher's persistence in using English and urging students to also use English to explain their answers.

At one point in the lesson, the teacher interjected when a student began to respond to a question in Shona:

> *You should always try to answer in English. Are you going to use Shona in the examination? The examination has no Shona questions and you are not going to be asked to answer in Shona. Now go on in English.*

The student gave up and sat down and the teacher did not bother to assist the student any further. Instead the teacher went on to ask another student to respond to the same question. Rather than acting as a facilitator of learning the teacher was an inhibitor of the learning process. This was evidence of disruption of significant conversation. What seemed to be happening in this class was that certain conversations that were conducted in English were explicitly legitimated as having a privileged status since the teacher, the authority figure, accorded them legitimacy. On the other hand, conversations conducted in Shona were delegitimated and dismissed as unworthwhile feedback. Teachers who disregarded the use of an indigenous language as an active learning tool treated students' responses as unimportant and irrelevant. In the process they disrupted the conversation process since the conversation apparatus, the indigenous language in this case, was disaffiliated from the student. They discouraged active learning and promoted docility and silence.

Although the language policy enforces the use of English as a medium of instruction, there are teachers who use both English and a local indigenous language to facilitate science learning. The teachers used code switching to help students grasp and understand concepts and processes in science. I noticed that during group discussions, students switched from English to Shona, but when they reported back to the teacher they struggled to use English, the language expected by some teachers. Students in all the classes I observed usually moved from the formal language of the classroom, English, to the informal language, Shona. This usually happened when the students were working on group activities. During the activities, there was a lot of talk in the mother-tongue. This finding resonates with Murila's (2004) observation in Kenya that primary students used a lot of Kiswahili when doing group activities in science. Murila concludes that the mother-tongue facilitates learning conversations since students would be using a language that is familiar and easy to use.

Although some teachers, in my study, would rigidly try to enforce the use of English as required by policy makers and school administrators, others allowed this interplay between languages, which they also used themselves, as the following dialogical exchange recorded in a Grade 4 class shows:

Teacher: *Let's look at those insects that fly. I think we have got a lot of them.*

Student: *Bete [cockroach]*

Teacher: *Hmm ... what do we call it in English?*

There was no response to the teacher's question.

Teacher: *Cockroach ... Hatidzizive? Mapete akazara munyika? [Don't we know them? Cockroaches are many in the country]. Name another insect.*

Student: *Chipfukuto [weevil]*

Teacher: *[laughs] what do we call it? Tinogona kungochinyora [Let's write it without its English name]. Do you know mbuya-mbuya? Mbuya-mbuya tinovaziva? Do you know its name in English? She is called the praying mantis.*

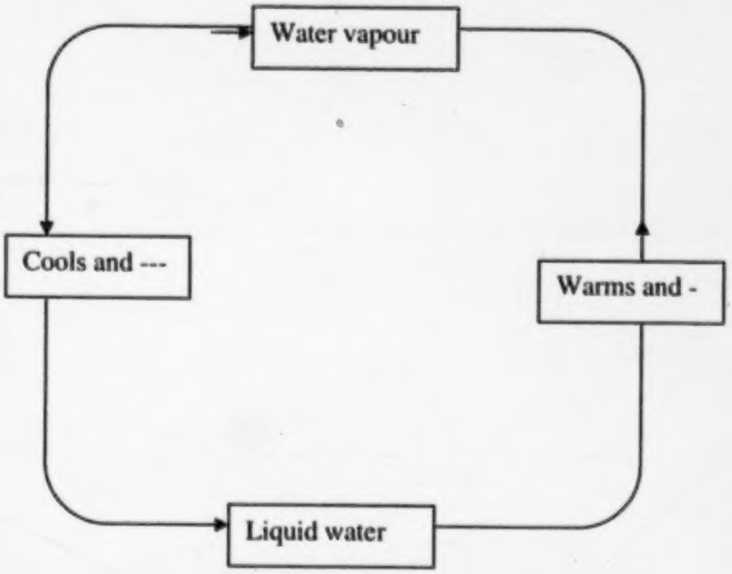
The above exchange shows how the teacher was code switching between English and Shona in order to make science meaningful to students. This is what border crossing is about, giving students space and the language to cross boundaries of differences. As Freire (1985) explains, the interplay in languages permitted by the teacher indicates the genuineness of some teachers to provide students with a language of hope, possibility and empowerment.

Classroom material artifacts and posters: what science story do they tell?

Classroom displays in the form of materials, or learning aids that were previously used in the class, can offer insight into the nature of science that is taught in the class. These materials were historical artifacts because they portrayed the knowledge that was taught prior to the lessons that I observed. The materials that featured in most classrooms were charts made by the teachers. In all the classes I observed charts/posters that were displayed on walls and had been used in previous science lessons. The charts had diagrams or statements and questions with information that teachers wanted their students to internalize, as shown in Chart I *"How water can change"* and Chart II *"The Water Cycle"* displayed in Grade 5 and Grade 7 respectively.

Chart I

Poster on *"How water can change"* on display in Grade 5



Water vapour

Cools and ---

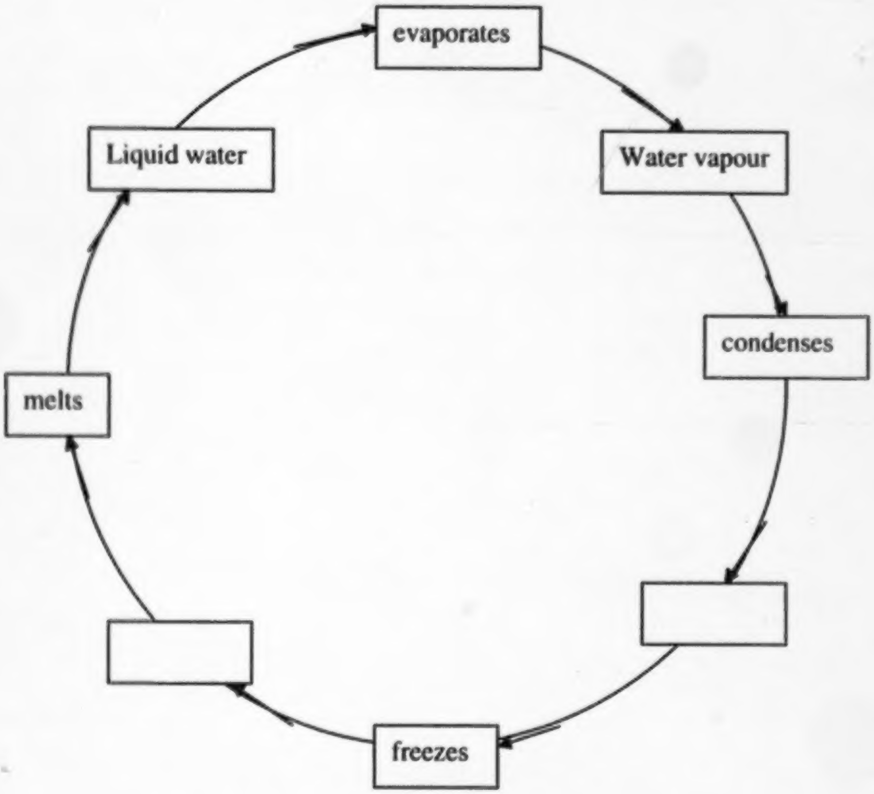
Warms and -

Liquid water

1. Water evaporates as vapour from the surface of liquid water.
2. Evaporation is fastest in warm and windy conditions.
3. The larger the surface of water the greater the amount of evaporation.
4. When water vapour cools it---.

Chart II

Poster on *"The Water Cycle"* on display in Grade 7


evaporates
Water vapour
condenses
freezes
melts
Liquid water

1. *Liquid water evaporates to form -------.*
2. *------- condenses to form liquid water.*
3. *Liquid water can ------- to form ice.*
4. *Ice melts to form ---------.*

Judging from posters that were on display in the classrooms, one concludes that emphasis in teaching science was given to "Western" scientific processes. Although these processes are vital if students are to develop scientific thinking and skills, they need to be presented in different forms that do not rely on the memorization of "facts." Pictures of children or parents boiling water at home or a shopkeeper serving a bottle of frozen cold drink could assist students to learn through practical life experiences. Posters that encourage students to tell their own stories could be made present in the classroom. Most children in Zimbabwe have experienced drought and its consequences. Stories on posters or pictures that portray drought could have been used to illustrate concepts such as evaporation. It can be reasonably inferred from the classroom artifacts that science in these classes was not presented from diverse perspectives and that students were not given the opportunity to approach topics from a multicultural perspective.

Analysis and discussion of Interviews

The following is a thematic analysis and discussion of responses that were given by the ten teachers who took part in this study. The analysis is in the form of quotations representing what was actually said by the teachers that were interviewed. In some instance, conversational analysis is utilized to show the dialogue that was carried out between teachers and students.

Teachers' definitions and perceptions of science and indigenous knowledge

The definitions that teachers give to science and their attitudes towards it are vital to knowledge harmonization and hybridization. When the ten primary school teachers in this study were asked to explain their views and understanding of the science that they teach in their classes, their responses varied. This small group ranges from those who perceived it primarily in its physical form to those who defined it in terms of the interaction between the physical and the social environment. Those who associated science with the study of the physical environment focused mainly on the empirical methods of studying science. They tended to exclude the social and cultural environment in their definitions and had this to say:

> *Science, I feel means manipulation of the environment you live in* (**Grade 4 teacher**).
>
> *Science, science is the study of nature. That's it in short* (**Grade 4 teacher**).
>
> *Definitely, I don't have a good understanding. I can't give a definition of the word 'science,' but I think it's to do with ... mmm ... how we live and ... ahhh ... how we manipulate our environment* (**Grade 5 teacher**).
>
> *Science, as I understand it and teach it, it is a subject about experimenting, finding out about things in general in everyday life. But, if you talk about 'science' you can't run away from the 'environment' because most of the things we will be teaching about have something to do with the environment. So, mostly you are trying to find things about the environment, anything that surrounds it. But all the topics in Science have to do with the environment, at primary level, that is* (**Grade 5 teacher**).
>
> *Science, right, in the primary sector... what we really teach here is what is known to the children. We do not really teach those abstract things, abstract concepts, which you find in secondary schools. So, it is the science that deals with those things, which are found...the science concerning those things, which are around them, which they meet in their daily lives* (**Grade 7 teacher**).
>
> *Science that I teach involves the use of our senses and it is about manipulating and investigating things and also there are a lot of skills involved with it: communication skills, investigating skills, and also we have got what we call...* [pauses]. *There is another skill that I forgot.* [Repeats skills] *We have communication, investigative...and...experimental skills* (**Grade 7 teacher**).

The above views are on objective and physical reality of science and are likely to have been influenced by the *Environmental Science Syllabus* that teachers follow in primary schools. In contrast, those teachers who included the human and social element in their definitions stated that:

> *[Science is] the study of nature, and how people interact with the nature and so on. That is the science that I teach as I understand it* **(Grade 6 teacher)**.

> *Science… hmmm… In fact, to me, 'science' is too broad a subject unless if we are specific like what you are saying. It is about the things, which are within the children's reach. What I teach here involves nature and the human aspect of it. Nature. In fact, the interaction between the human being and the nature itself* **(Grade 5 teacher)**.

When the ten teachers were further asked to describe their methods and techniques of teaching science, their reply was that their methods were embedded in "investigative science," which focused on proving theories and finding evidence that supported or contradicted "theories" or assumptions that they had selected from textbooks. The teaching techniques were planned in such a way that students were led to discover "knowledge" that was already defined by teachers, as worth knowing. The following are some of the methods that were described:

> *Okay, when I teach science we use the hands-on-approach whereby the students learn by doing and by seeing, in fact, using all the senses. That's why the environment is always the best to revolve around when teaching science. The lecture method in the class may be to introduce [the lesson] then I say, "Let's go out and see what we are talking about." And when the child feels or when the child touches the child will be able to discuss with the others. To some extent, fine, the child fails to grasp the concept in the classroom but when we go out I think the child does understand when using the hands-on approach* **(Grade 7 teacher)**.

> *To assist them, of course we use ..emm.. some learning aids, prepared learning aids, or the use of the environment to show them what it really is. It could be a topic on Soil Erosion, right, we need to go out there and show them the eroded areas. So the use of the environment is very useful in that. For example, I enjoyed teaching the lesson you saw on Materials Change. The topic was on investigating changes in materials, some changes are reversible, and some are non-reversible changes. I gathered a lot of things to demonstrate or explain the idea and those items that were used were very materialistic in form and pupils were able to see that this is exactly a reversible or an irreversible change* **(Grade 7 teacher)**.

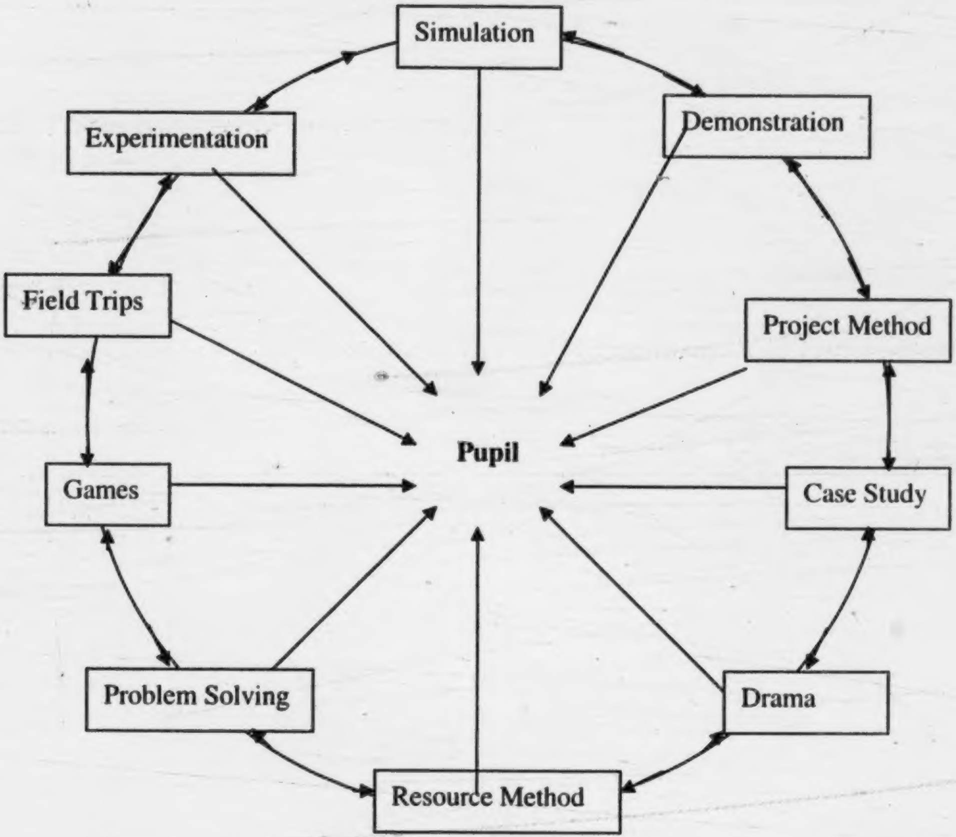
> *Science involves investigating things. Like in one of the lessons you saw me teach that day, it involved some collection [of items, or objects]. So,*

> *it's part of the outside work out of the classroom, and how to investigate changes that took place that was the experimental part of it in the classroom. My students have learnt a lot and they have had much exposure to experiments and they are now doing better than before* **(Grade 7 teacher)**.

Teachers emphasized investigation and experimentation as the main methods they used in teaching science. These are methods and techniques employed when empiricism is the dominant perspective used in teaching science. These are also teaching techniques that all the teachers were observed using during their teaching. They used experiments to investigate and test hypotheses that were suggested in textbooks. For example two classes, a Grade 6 and Grade 7, carried out experiments to demonstrate that materials change shape, texture, form and size when exposed to different conditions, such as heat. This was the dominant perspective that this group of teachers used to create and reproduce "scientific" knowledge. They perceived knowledge as already out there, waiting to be verified through gathering evidence to verify the existence of "scientific facts" that were provided by the teacher, texts and syllabus. In these definitions and teaching techniques, no open space is given to the social significance of science as a body of cultural knowledge. Both the definitions and teaching methods ignore the reality that knowledge is a culturally embedded phenomenon. The teaching methods and techniques used by these teachers, moreover, were selected from among those suggested in the *Primary School Environmental Science Syllabus*. These are summarized in the following chart:

Chart III

Activity based methods that could be used to teach science


Simulation
Experimentation
Demonstration
Field Trips
Project Method
Pupil
Games
Case Study
Problem Solving
Drama
Resource Method

Source: *Curriculum Development Unit (1994)* Primary School Environmental Science Syllabus: Grade 6 and 7. *Harare: Ministry of Education and Culture (p. v).*

Indigenous knowledge/science in the primary school science curriculum

This group of teachers did not all share the same view of science that they taught in their classes. Although they used the same curriculum, same syllabus and the same textbooks, they differed in terms of their thinking and perspectives on science in primary schools. Two categories or schools of thought emerged from my discussions with these teachers. One group did not distinguish between indigenous science and Western science in their teaching; the other felt that school science was "Western" and therefore did not believe that indigenous science was "real science." What came out of these discussions mirrored what I had observed during class visits. While in some classes teaching and learning situations seemed to be inclusive of "some" indigenous knowledge, in others there was no attempt to incorporate cultural knowledge in science lessons.

Category 1: Indigenous knowledge is part of school science

Teachers, in this category, argued that there was no separation between sciences. They argued that science, whether "Western" or "indigenous," belongs to the same domain of knowledge. Their argument was that differences are discernible in the way we derive meaning from and make sense of our different cultural worlds. These teachers seemed to be self-reflectively in favour of the link between indigenous knowledge and school science, and appeared to be working towards merging the two. They did not marginalize or exclude the incorporation of indigenous knowledge in their teaching of science. Neither were they skeptical nor cynical about indigenous science. As the following shows, they talked about the fluidity and compatibility that exists between the "Western" science and "indigenous" science in Zimbabwe:

> *Like I have said earlier on, it would be very difficult to say this is traditional science because the idea of teaching from simple to complex means that if you are teaching anything you need to teach*

> *using the immediate things that the children are there to understand. So, it is therefore, incumbent upon us teachers to try to narrow down to bring down that information from the community. So, I wouldn't actually be very comfortable with the words traditional and Western. As much as possible I try to interact the two because there is no way that I may want to teach Western science without the traditional aspect in it because it is one that is so immediate to the children* (**Grade 7 teacher**).

When this teacher was asked to give examples of indigenous knowledge or science that had been incorporated in the lessons I had observed, the teacher laughed and responded:

> *Well, it is going to be very difficult [to say] because we have been westernized in such a way that we tend not to worry about this traditional science. But basically, whatever we teach, I think, is traditional science. Maybe, it is the language that we use and the things we use that are westernized.*

Teachers in this group did not see boundaries between indigenous science and formal science taught in primary schools in Zimbabwe. They understood science to be one body of knowledge that does not need any classification or categorization into Western science or indigenous science. Their perception was that science is the same everywhere, as the following statements from some of them indicate:

> *The science we teach is the same. Yaah...like teaching about medicines, you know traditionally we have got the* ***n'anga*** [traditional healers], *and we have doctors in modern science, those go hand in hand* (**Grade 5 teacher**).
>
> *Ahhh...the science we teach in the school and that one found at home and in the community are part and parcel. They augment each other; they complement* (**Grade 6 teacher**).
>
> *In teaching you can't say this is Western science or indigenous science, or this is an indigenous method of teaching science and this is a modern method. If you use an experiment, it's an experiment. Maybe, what can only be indigenous could be the apparatus that you can use not the type of method of teaching. The methods of teaching are all the same* (**Grade 5 teacher**).

When asked to clarify and give examples of indigenous apparatus that were used in teaching science, this Grade 5 teacher went on to say:

> *An indigenous apparatus, maybe…mmm…**choto** [fireplace], if you want to make fire. Remember, in that lesson you saw, we set the stones and the firewood for preparing the fire. A fireplace in Shona is different from a fireplace in English. Water sources are also different. We [indigenous people] have **matsime** [water wells] and the like. In this community they have boreholes, which are different from the modern ones that we have here at school. If you go into the community they have their own boreholes.*

The teacher also argued using the traditional healing system as an example to support the idea that the science taught at school and that which is practiced in rural communities is the same, in spite of cultural differences:

> *The science that we teach in school and the one practiced in the community is the same. It's more or less the same. To me it's almost the same thing. I come from a very remote and cultural family, so, if I can think of the work by these, our traditional healers. They use plants as their medicines, so I think that can be co-opted in teaching science. Say, looking at diseases like diarrhea, these common diseases, I feel children should be taught about these plants, which are useful to our health, although it's under the traditional healers' area.*

Although these teachers seemed very supportive of incorporating indigenous knowledge in formal science, I could not clearly identify and distinguish it from the formal science they were teaching during my lesson observations. It is possible that when they incorporate indigenous science in their teaching, they do not plan for it but indigenous knowledge comes into the science lessons as examples used to support the importance of formal science. The ideas expressed by this subgroup of teachers show that if they incorporate both indigenous knowledge and "Western" science, they are doing justice to multicultural science. In implementing this, they are capable of fostering culturally sensitive teaching styles, which provide "science for all." This is the effort required to assist students to cross cultural borders between their everyday worlds into the "foreign" culture of the school science, without running the risk of assimilation (Aikenhead, 1997).

One teacher explicitly explained how he had experienced multicultural teaching and adopted contesting views on cultural differences while teaching about *rain formation* in science. When I asked the teacher what he thought about incorporating traditional or indigenous knowledge in the science program in primary schools, the teacher had this to say about his opinion and experience:

> *Yes, I agree with you that children come to school with traditional beliefs and customs that they acquire at home. For example, in one lesson we were talking about epidemics and natural disasters. We were discussing drought as a natural disaster that can happen because of environmental problems. But one child said to me, "Look teacher, there is **chitwa**, why can't we perform it?" Do you know **chitwa**? It's a traditional culture, whereby elders used to brew beer for the rainmaking ceremony. That child asked me if it helps because this was happening in their community. With this belief in mind I was asking myself, "But does this help? Are we going to have rain after this ceremony?" I told the class that it was our culture. "It is practised. Yes, we can have rain." That's the traditional belief that I encountered in that lesson. But you still explain to them about the weather, the weather changes that sometimes affect the pattern of rain* **(Grade 7 teacher)**.

This example highlights the sensitivity with which the teacher treated the student's question and how the teacher aptly incorporated traditional beliefs into the teaching of a natural phenomenon. The teacher showed that it was possible to incorporate indigenous knowledge when teaching formal science, without devaluing students' cultural knowledge. When I observed this teacher teaching on *Material Change* I felt that he was doing his best to incorporate indigenous science in his teaching of formal science. He allowed students to talk about objects that were relevant to their lives. Some of the objects and materials they mentioned are found in almost all indigenous rural homes. Later, when I discussed with the teacher the place of indigenous science in what was referred to as "school science," the response was:

> *Last week when we were talking about changes that are useful we talked about "molding and firing clay pots," it's something that happens in our traditional setup. Our grandmothers, they mold those things and also fire those things. So I think that's part of indigenous science that we are taking into our lessons today. One boy also talked about "molding cattle," these are clay toys the boys make when they are herding cattle. It is a cultural pastime for them. "Molding" and "firing" make materials such as "clay" change. That is what my objective was in that lesson.*

Clay molding is an important aspect of life for both adults and children in rural areas. Adults use clay to make traditional pots for cooking food in as well as for brewing beer and keeping water. Every rural household has these pots and they are an important asset for rural women. Children, both girls and boys, use clay to mold toys that usually imitate life in rural villages. These toys include clay cattle, dogs and goats, as well as clay pots and plates. Both adults and children make these clay objects strong by "firing" them in hot furnaces. Thus, science is much alive in rural communities and if this cultural knowledge is used in schools, it is likely to help students make sense of formal science.

A Grade 5 teacher stated that he had grown up in rural Zimbabwe and he suggested that perhaps, it was his socialization that greatly influenced his approach to the teaching of science and how he incorporated cultural perspectives in it. The teacher's own socialization into the family and community values, beliefs and customs had somehow motivated him towards inclusive teaching of science:

> *My teaching of science, I mean compounded by the fact that I come from a very remote and cultural family, I do believe that it involves what I have grown up experiencing. I learned those things as I was growing up and thus I accept what children believe in and try to*

> *bring it in my teaching. For example, when I was teaching a lesson on "Insects" I did not dispute a child who stated that locusts and white ants were destructive but had nutritious food value. Africans eat them as a source of proteins so it was traditional knowledge, which saved to develop the ideas that I wanted to teach.*

As one teacher pointed out earlier, it is our educational backgrounds, and being products of colonial education and Western hegemony that make us think that science is a Western concept. The education system that most teachers went through defined "science" as a Western empirical and rational body of knowledge, while indigenous practices and ways of knowing were cynically perceived to be irrational and unscientific. This colonial legacy continues to be perpetuated by those teachers who represent the second category described below.

Category 2: Western science and indigenous knowledge are independent of each other

Teachers in this subgroup portrayed or displayed the characteristic that was described by one teacher in the other category as *westernized* and *colonized.* These teachers categorically dissociated indigenous knowledge from Western science in their teaching of science. They did not perceive formal science as a construction and creation of indigenous experiences. For them, social knowledge or cultural knowledge had no place in the teaching science. School science and indigenous knowledge are polarized and in opposition to each other and are also defined and perceived in their dual context of modernity and traditional. The teachers who equated school science with Western science were cynical about indigenous knowledge. Their reaction when asked how they incorporated indigenous knowledge, culture, traditional beliefs and customs into their science lessons were the following:

> *What we are teaching is Western science [laughs]. Traditional science has no place in our curriculum in the teaching of science [laughs again]. Beliefs and customs do not have a place in teaching science, but in other subjects like Religious and Moral Education, and Social Studies, but in science, no [shaking his head]. Traditional knowledge is important only at home. When teaching science traditional beliefs have to be corrected. We need to correct such beliefs in pupils because here we are trying to explain causes of things* **(Grade 7 teacher)**.
>
> *Ah...indigenous knowledge usually has old values, which they carry for generations and hence you find that the experiences that the children have are usually the old information that they are taught by their elders. That information won't work, because you know, everything is developing. With IT (Information Technology) and everything, you can't always rely on the old methods of living. You have to improve because their parents are the only ones who can only use those old methods of living* **(Grade 5 teacher).**
>
> *Let's take things as they are. Our country, in fact, is a multi-cultural one so much that you find different groups saying different things, some which may contradict each other. So you see, you can't get a definite theme on indigenous knowledge or sciences. There is a sort of conflict as I can see* **(Grade 5 teacher)**.

The concept of science and the treatment of science expressed by the teachers in this category are based on drawing a contrast between a "dynamic modern science" and a "static, traditional one," that is, between a "rational" West and a "mythical" Africa. These teachers portrayed science as a hierarchical structure, with Western science being superior to indigenous science. Western or Euro-centric perceptions of science were accorded a higher status than indigenous perspectives. The teacher, who characterized Zimbabwe as a multicultural society, was correct, but misrepresented what should be taught in multicultural schools or societies. To advocate a monolithic science is to negate the existence of difference and diversity in multicultural societies. In addition, a dualistic approach to science, that is, "Western" versus "indigenous," promotes unequal power distribution in knowledge recognition, dissemination and utilization. The teacher seemed to view school science as impartial and authentic to all cultures. This view is embedded in hegemonic colonial constructs, which are self-defeating to and disenfranchise learners. It also disempowers learners since it silences many of their voices. The conflicts and unevenness characteristic of science practiced in school and outside the school are largely due to the pervasive influence of colonization, "civilization" and "modernization." There is no magic international "standard" of science, no "modern" or "old fashioned" science, but only science, which proves more or less efficient and appropriate to needs of a particular society. Differences exist in cultural ways of explaining and making sense of science concepts and applications taught by teachers.

When teachers in this category were asked to explain why they felt that the two forms of science could not be taught together without any hierarchical classification, their responses tended to demonize indigenous knowledge. They discounted indigenous knowledge as illogical and irrational, whereas Western science was glorified and described as rational, authentic and reliable while at the same time reflecting the "truth." These sentiments were common to their responses as shown in the following extracts:

> *We need to correct traditional beliefs that pupils bring to school because they are not rational. If we allow them in class, we are not developing any science knowledge in the children. Indigenous knowledge is difficult to prove, very difficult to prove. Western science has proof, while indigenous science, basically, lacks proof* (**Grade 7 teacher**).
>
> *Traditional knowledge and its beliefs and customs are beyond our re [cognition]. We can't get the whereabouts of it. Because such knowledge doesn't have proof, so we have to mention this indigenous knowledge in other subjects. In science it is difficult, because we may say that someone is bewitched when the person has poisoned himself* (**Grade 5 teacher**).
>
> *Right, our science that exists in the community is not written and Western science is documented, we can have reference to it whereas ours we cannot* (**Grade 5 teacher**).

During my discussion with teachers in this category, most of them responded by shaking their heads when the idea of incorporating indigenous knowledge into the teaching of school science was suggested to them. Usually, their negative body language was accompanied by cynical laughter. Even the tone of their voices was dismissal and at times conveyed a sense of disbelief and ridicule. These teachers were skeptical of indigenous knowledge and seemed to prefer to continue teaching assimilative science that is not culturally sensitive to the cultural site in which this rural primary school is located. Jegede (1995) suggests that one way for teachers to avoid assimilative practices is to sensitively integrate students' indigenous knowledge of nature with the content of Western science. In contrast, the responses I got from these teachers when I asked them why it was not possible to integrate indigenous knowledge with school science were shrouded with skepticism:

> *We need to be* ***very, very careful*** [says with stress] *of traditional beliefs or customs in the teaching and learning of science. Some of the information that they [students] bring might mislead you [teacher] or mislead other children* **(Grade 7 teacher)**.
>
> *Indigenous knowledge, traditional beliefs and customs are misleading in teaching science. For example, when we were doing a lesson on Lightning some children believed that a person can be struck by lightning for wearing red clothes. The community, the old people themselves believe that and that knowledge is also within the children. They have acquired it and they take it as true. But when we teach that topic we try to make the children understand that the colour does not necessarily mean that you will be struck by lightning. It is the position in which you are. Your being the highest point or nearest to a tall object or probably, if you are just close to where lightning is taking place, you can be struck. So we can get rid of that belief that red clothes can make you get struck by lightning* [laughs] **(Grade 7 teacher)**.

The teachers tended to promote the dominant perspective of Western science as the only form of science. Perhaps, these teachers see themselves as the only source of "legitimate" science knowledge, thus deriving power and control from it, power which they probably, are unwilling to give up. Their understanding of "science" was deeply rooted in Euro-centricism and colonial education that may have influenced and shaped their thinking, vision and definition of reality. It appeared as if the teachers paid more attention to what was being taught than to how the cultural backgrounds of the students influenced how they learned science. They, consequently, do not believe and respect the credibility of the reality that is defined by the social and cultural confirmations of indigenous cultural institutions. Through their negation of meaningful learning, these teachers may well be seriously undermining their efforts to create a safe and caring learning environment for their students. A safe and caring classroom environment incorporates students' histories, cultural meanings, community stories; it is a pedagogical practice that encourages learning through shared experiences and understanding. Although I seem to be critical of and harsh on this category of teachers, I am aware of the systemic pressure on them. The examination system, language policy and other policy issues tend to require that teachers adopt a certain attitude towards formal science and indigenous knowledge. These issues will be discussed later in the chapter.

The home and the school: parental involvement in science teaching

The way children understand and construct meaning from the science they learn in rural primary schools of Zimbabwe is likely to be affected and influenced to a great extent by their social and cultural environment. The family or home is likely to shape how children make sense of the world around them. School and home are sites that are implicated in science knowledge production. Students are subject to familialisation, whereby there is an emphasis on the responsibility of the parents in shaping their behaviour and attitudes. In this study some teachers expressed reservations on whether parents and elders in the community should play an active role in the teaching of science in schools. Covertly, the teachers could be actively engaging in discouraging parental or community involvement in bringing community knowledge or indigenous science into the classroom. They perceived the majority of parents as too illiterate to be engaged in the "technicalities" associated with "science." The teachers expressed unequivocal assumptions about the ability of parents to effectively help their children in the practicalities of science. The major assumption seemed to arise from the teachers' failure to connect cultural science practiced at home and the "science" that is taught in schools:

> *As a teacher I would say that it is quite controversial because... fine ... science is a subject for schools. Like I was telling you, science is too technical. Some people have that negative attitude towards science, not that they don't want it but it's too technical a subject. You can't expect a parent to say to a child, "We want to do this experiment at home." They don't have that eagerness to do that because they just shun science. Science is too technical, you have to love it, you see. You just have to love it so that you always have to practise it with children. So science is taught at school by teachers. Sometimes again it's a question of having apparatus and having the correct tools and the correct apparatus. I don't think a parent in this community would be able to use the apparatus to do the experiments with the children at home. That's far away from the parents* [laughs]. *That's why probably science is taught at school because* ***isusu*** [we teachers] *we have to teach it because it's there on the timetable and it's our job* **(Grade 7 teacher)**.

> *It is our duty as teachers to teach science. Parents are not aware of what is involved. It's like they need to be aware of what is involved in school science. If you teach their children about food nutrients in general, they will get a better understanding of what they will be doing at home. They [students] can even teach their parents because most of them are illiterate. What they know is mainly traditional aspects of life* **(Grade 5 teacher).**

Based on this point of view, one can conclude these teachers were protective of their classroom spaces and see their roles as autonomous from parental "interference." They perceived science as a technical body of knowledge that should remain impervious to social and cultural distortion of traditional community life. As such, parents and the community should stay clear of teachers' private sphere and professional zones. They were not in favour of creating parental and community spaces in teaching science in "their" classrooms. The teachers were, moreover, apprehensive of the presence of parents in their classrooms. They felt that science taught at school was separate from home life. They argued that the teaching of science at school was too technical and based on experiments that parents were not familiar with and were unlikely to be able to carry out. The teachers' resistance to the involvement of parents in their children's classroom experiences meant alienating the students from the rich home and life experiences with which they were familiar. These teachers, in effect, were bent on reproducing colonial teaching methods that perpetuate cultural barriers of silence, even though in Zimbabwe. The functional and socialization boundaries between home and school are supposed to be becoming ever more ambiguous and blurred in today's classrooms.

Although there was a subgroup of teachers who appeared unprepared to create welcoming environments for parental participation in their classroom, there were others who did not completely rule out the participation of parents in the school's science program. However, their acceptance of parental involvement was selectively dependent on the "expert" knowledge that they "appropriately" judged parents to possess. Noteworthy is that most of the knowledge that teachers welcomed from parents was of a technical or specialized nature in the sense that it had little to do with indigenous science or knowledge. The following is what some of the teachers had to say:

> *I believe that parents should be invited, if it's a good community with parents who are technical in some science area. Why can't we have one coming in, through the administration, get a timetable and be told a day when he may come? The administration should talk to parents and say we want our children to develop an interest in science. The person who is an expert in such and such an area, teaches the children while the teacher is watching, helping here and there to some extent. That will benefit the children, and the parent will have done something great* **(Grade 6 teacher).**

> *Resource persons from the community are just good when they know more than what I know. They are very good; they are beneficial. Some, they have got that knowledge that we lack as teachers* **(Grade 4 teacher)**.
>
> *We do not use resource persons in science only but also in every subject. When you feel you do not have the data or you feel the resource person has better knowledge, there is need for you to call that person. I think it is very resourceful to do that. If there is someone within the school who can do that, you can invite him* **(Grade 5 teacher)**.

Teachers who claimed they had once invited parents or local people to help inject traditional knowledge into their lessons had confined them to such modest contributions as naming indigenous trees and explaining local idioms and proverbs. Parents were invited to assist in Shona Language lessons rather than in science. Lack of teacher initiative and resourcefulness seemed to limit the extent to which indigenous knowledge brought into the classroom by parents could be extended to explaining scientific principles that are used by indigenous people in rural areas of Zimbabwe. For example, trees are known to have medicinal values and are also a source of food. Parental knowledge about trees could be usefully put to teaching environmental management and conservation from indigenous perspectives. To limit parental knowledge to the mere naming of trees and explaining proverbs is to devalue and demean parents as a vital source of science knowledge. When the teachers were asked if they had ever invited parents to their science classes the responses were typically negative:

> [Laughed first before responding]: *No, not in science, I have never done that but at one time when I was teaching in Karoi* [a rural area in Zimbabwe] *I brought in a parent to help in Shona to teach idioms which needed explanations and some stories attached to them. But it calls for a lot of dedication and commitment* **(Grade 7 teacher)**.
>
> [Laughing and shaking her head]: *No I haven't done that. Most parents in this rural community are illiterate. They are not experts in science* **(Grade 5 teacher)**.
>
> *I once invited a local person to when I was teaching* ***tsumo*** *[Shona proverbs in Shona Language] and* ***kugara nhaka*** *[inheritance]. In science, I was teaching the pumping of the heart and I invited someone from the hospital* **(Grade 6 teacher)**.

When teachers laughed and shook their heads before responding I got the impression that they did not take parental contributions seriously. It also showed the negative attitudes the teachers conveyed towards parents as sources of important scientific knowledge that can benefit both the teacher and the student.

Are teaching and learning aids used in teaching science indigenous?

Teaching and learning aids reflect much about the science that is taught in schools and the opinion of teachers about that school subject. These aids may be prepared by the teacher, bought, supplied by the Curriculum Development Unit, or brought by students from home. Teachers who participated in this study complained about the scarcity of teaching material in science. The following statements express the opinion of some teachers that to teach science one required specialized material:

> *There are times when you find it difficult to tackle other topics especially those that need some material, prepaid materials. For example when you are talking about "pressure," we don't have some of those instruments that are used like the barometer. So it will be difficult to make a child understand that this is the instrument that is used to measure pressure. Of course we can make other things like the cup anemometer and the wind vane but for pressure, the barometer is difficult to make. So they just know that the barometer is used to measure pressure* **(Grade 7 teacher)**.
>
> *At times some topics do not have the resources that may be required at that particular moment. So you would end up taking it [topic, concept] as something abstract, whereas all scientific items need to be done with real objects* **(Grade 4 teacher)**.
>
> *Long back the teaching of science was not as effective as these days. Then, there were not enough facilities and teaching material like these days. Today in rural schools we need something like labs and classrooms with electric gadgets* **(Grade 4 teacher)**.
>
> *Emmm ... science can be made less technical by providing kits, science kits, and some apparatus for children to use. In fact, a laboratory is always best to teach science because teaching science in the classroom using some improvised materials... you know... we are looking at the child who is probably going to be a scientist and who is probably going to*

> *assume professions, which involve science in careers. We need to teach things which are real things using actual things that the child will probably use in the future* **(Grade 7 teacher)**.

Some of the material that some teachers yearned for had questionable relevance to the rural setting where the school was located. It is unlikely that the skills students would acquire from using such materials would serve practical purposes in either their homes or communities. However, the school head had a different opinion concerning the availability of science materials. He pointed out that the Ministry of Education and Culture had provided a science kit that was available in the office for teachers to use:

> *The Ministry has given us a kit, a science kit, which has almost everything. When they are teaching science they can also take beakers, they have all these tapes and so on, which they must be using outside. But sometimes they forget so you have to encourage them to use it. However, we have the kit box, which was working very well for some who have used it. I wonder whether during your visits you have seen some of them using it.* **(school head)**.

During my class visits, when I was observing science lessons, I did not see a teacher using the science kit referred to by the school head. What I could not determine, however, was whether or not the science kit was suitable for all the lessons I observed. Perhaps the teachers ignored the kit because they deemed it irrelevant to the rural environment in which the school was located. One can also speculate that, for whatever reason, teachers were failing to adapt the science kit to their science lessons. The kit may also represent the primary school science that the Ministry of Education or the government preferred teachers to teach. It is possible, too, that the science kit was designed and prepared by the Ministry without due consideration of its applicability in the different localities in which rural schools in Zimbabwe are located. Further, one could also ask whether the kit is culturally appropriate and useful to incorporating indigenous ways of explaining scientific phenomena. When this question was posed to the school head, his opinion was:

> *Indigenous, no, there is nothing indigenous about it. What you find in it are the beakers, test tubes, bottles, tapes and so on. There is nothing actually in terms of indigenous. There is nothing you can refer to as indigenous in it* **(school head)**.

It appeared as though the science kit was prepared and designed for a particular type of science: usually Western scientific methods of investigation that seek to prove or disapprove theories. The absence of items or materials that could be described as indigenous suggests that the government's view of science continues to be still rooted in colonial and Euro-centric knowledge constructs. The government policy on indigenous science appears more rhetoric than practice. For the most part, teaching materials designed and provided to schools are insensitive to the environment in which rural primary schools operate. Perhaps this explains why the science kit issued to this rural primary school was underused.

Teaching materials that accompany the science program in rural primary schools should take cognizance of and accommodate the cultural environments from which students come. Therefore, primary school science kits should incorporate both non-indigenous and indigenous apparatuses to expose students to scientific principles and attitudes from a variety of perspectives and experiences. For example, instead of providing beakers and filters to help teach about "filtration" a traditional sieve called *surudzo* could be included in the science kit so that students can experience how both indigenous and non-indigenous apparatuses work to achieve the same scientific purpose.

The ten teachers who participated in this study pointed out that the materials they used in teaching science came from the local environment. Sometimes the classes went out for specific lessons, depending on the topic and concepts the teachers were teaching. Students also brought other materials from their homes. Here is what some teachers said by about teaching materials:

> *To assist children to understand the science concepts, of course we use … emmm … some learning aids, prepared learning aids or we use the environment to show them what we will be talking about. It could be a*

> *topic on Soil Erosion, we go out there and show them the eroded areas. So the use of the environment is very useful in that* (**Grade 5 teacher**).
>
> *The teaching methods and materials I use, I may say it's half-half. Because the resources or apparatus that we use, we find them in the environment and most of them are indigenous* (**Grade 5 teacher**).
>
> *Usually I use the participatory method; children actually do the action, or do things or hold things in reality. For example, like the management of the veld, it's easy for me to take them in the veld there and they compare velds. They can see that in protected areas the damage is less as compared to open areas where the grass is always grazed by the animals. However, there is also material that children can bring from home. Usually, the material is brought as feedback to the lesson that we will have done, or in preparation for the next lesson. For example, the children brought all the material you saw being used in that lesson on Materials Change. Some of it was collected from their immediate environment* (**Grade 7 teacher**).

As Table III and IV show, the list of suggested learning resources in the Grade 6 and 7 science syllabi include some local and teacher-made learning resources. The extent to which the materials were culturally appropriate depended on how the teachers used them to fit the cultural environment of students and schools. The use of the local environment, if well thought and utilized, is vital to generating community-level knowledge systems. The local environment reflects the customs, traditions, values, beliefs, interests and institutions of local indigenous people. Unfortunately, when using the local environment the teachers in my study were interested primarily in its physical nature and disregarded the connection between the physical, spiritual, cultural and the economic. For them, what was more important was to show how the physical could be "scientifically" explained. Cultural connections and links were marginalized because *"...of the absence of instruments and mechanisms to use indigenous people's own knowledge"* (**Grade 7 teacher).**

Table III

Suggested learning resources for Grade 6

TOPIC	GRADE 6 SUGGESTED AIDS
Water	i) Water in three states where possible ii) Containers iii) A source of heat and of cooling iv) Prepared diagrams
Soil, Grass & Grazing	i) The environment where rocks and stones are breaking down ii) Rocks, stones, soil and water iii) Transparent containers iv) Pictures and drawings of weathered rocks
Trees & Forestry	i) Trees in the environment ii) Prepared drawings and diagrams iii) Plastic and strings iv) Prepared graphs v) Medicines from trees vi) Furniture vii) Pictures of trees
Crops & Animals	i) Maps of Zimbabwe showing areas where main crops are grown ii) Crops such as maize iii) Pictures and drawings of wild animals
Health & Pollution	i) Diagrams and prepared information about human reproduction, immunity, STDs and AIDS ii) Pamphlets and literature about STDs and AIDS
Energy & Fuels	i) Torch cells and/or batteries ii) Torch light bulbs iii) Non-metals such as wood & coal iv) Various types of wire, including copper wire v) Insulating tape vi) A domestic electric plug vii) A low voltage bell & bell switch
Weather	i) Balloons, containers, plastic, rubber, string, newspapers ii) Maps, pictures, diagrams iii) A bicycle pump
Materials & Technology	i) Pieces of wood, metal, rubber ii) Bicycle & car wheel, wheelbarrow iii) Soles of shoes and soles of feet iv) Vices and other machines v) Tyres, handles, oil and grease vi) Plastic and glass cutters
Landforms & Maps	i) Prepared maps, atlases, compass ii) Templates of maps iii) Measuring instruments iv) Squared paper

Source: Curriculum Development Unit (1994). *Primary School Environmental Science Syllabus: Grade 6 and 7.* Harare: Ministry of Education and Culture (pp. 3-23).

Table IV

Suggested learning resources for Grade 7

TOPIC	GRADE 7 SUGGESTED AIDS
Water	i) Water and transparent containers ii) Compost, soil and sand to make water dirty iii) Different types of cloth, sieve and sand filters iv) A source of heat v) Various substances which dissolve and do not dissolve in water
Soil, Grass & Grazing	i) Vegetation and animals in the local environment ii) Diagrams, drawings and graphs iii) Grass crop plants, grain seeds iv) Pictures of grass crop plants v) educational films (where possible)
Trees & Forestry	i) Trees in the environment ii) Diagrams and graphs showing types of trees iii) Diagrams and drawings showing annual rings of softwoods and hardwoods iv) Softwood and hardwood objects
Crops & Animals	i) Diagrams and prepared information ii) Plants and means to deprive plants of light, air and water iii) A food chain and a food web in the local environment
Health & Pollution	i) The human body ii) Drawings, pictures and models iii) Plastic bags, pieces of plastic, water and petroleum jelly iv) Blood circulation game v) String and elastic bands
Energy & Fuels	i) Rulers and desks ii) Musical instruments and other objects to make sounds iii) Radio iv) Prepared diagrams of telephone, radio and television transmission
Weather	i) Papers, threads, plastic objects and feathers ii) Diagrams, drawings, and pictures iii) Modelling materials iv) The local environment
Materials & Technology	i) Plasticine, clay, wood, water, soapstone, paper, plastic, cloth, various foods, metal objects, dyes, glass, chinaware and clay pots ii) Tools to use in investigations iii) A source of heat
Landforms & Maps	i) Atlases, globes, various maps and charts ii) A provided aerial photograph iii) Ground-level photograph iv) Map of the same area v) A provided satellite picture

Source: Curriculum Development Unit (1994). *Primary School Environmental Science Syllabus: Grade 6 and 7*. Harare: Ministry of Education and Culture (pp. 27-46).

There is a variety of teaching material suggested in the primary school science syllabus as indicated in Tables III and IV. The lists incorporate materials that could be found in different socio-cultural environments. Some materials are available in the local environment of the students and others were to be bought, provided by the Curriculum and Development Unit, while teachers had to prepare charts and diagrams. Although the materials may be available locally or in the environment of the students, the onus is on the teachers to make them culturally sensitive to learning styles and needs of students. Teachers could use their imagination, creativity and ingenuity to socially and culturally adapt the teaching and learning materials to suit the learning situations in their classes.

The relevance of science that is taught in rural primary schools

The question of the appropriateness or relevance of science that is taught in rural schools in Zimbabwe, as in other developing nations, is very contentious. Weber (cited in Cronin, 1996: 223) argued that "no scientific system is ever capable of reproducing all concrete reality, nor can any conceptual apparatus ever do full justice to all infinite diversity of particular phenomena." Thus, to expect all scientific knowledge taught in schools to fully cater to all cultural differences would overstretch the teachers' and the schools' capabilities. Nevertheless, schools should attempt to fulfill the expectations that the communities surrounding the schools have for their children.

Scientific knowledge that reflects the cultural reality of the people in which the school is located may be deemed relevant, if the members of that community find meaning in it and make use of it to improve their social conditions. It would be speculative to conclude whether the science that was taught in the school is relevant to the needs of students or their rural communities. To determine this one would have to undertake further research into the opinions of members of the community and school leavers. The teachers who took part in my study, however, felt that the science they teach in their rural primary school was indeed relevant to their students and to the community at large. What seemed to be the standards on which to determine whether the "knowledge" being taught in class, as "science," was considered relevant to the students and the community were the following:

a. that the "informal knowledge" or "commonsense knowledge" presented in class was related to what students experience everyday at home;
b. that the "knowledge" or the skills acquired have a possibility of increasing students' future employment prospects.

School science and informal knowledge

Some teachers assessed and judged the relevance of the school science that they teach in their classes on the basis of its similarity to the informal knowledge: the everyday knowledge of the communities. They argued that the science they taught was the same as common knowledge that children experienced in their communities. The scientific knowledge they were referring to covered an elementary understanding of the processes of nature in the particular areas pertaining to health, and sanitation, to raising crops and animals, to nutrition, food storage and preparation and to the environment and its protection. The following were some of the sentiments expressed by teachers who shared this view:

> *In one of the lessons you watched me teaching we were talking or dealing with the topic on bees and trapping bees. That is a practice that is in the villages. So next time when one sees a swarm of bees, he can help others or suggest making a beehive and trap them. It is a traditional thing because I was stressing that it is [the beehive] made from the bark of the trees and they can make one from drums, empty drum also* **(Grade 4 teacher)**.

The teacher went on to explain the story that she had read to the class to make learning relevant to the students' life experiences. The teacher said about the story:

> *The story was about bees and we discovered that there were some people at home who haven't been to school but have the knowledge or know-how of doing something. The story was about a certain uncle, Uncle Zaka who used to make some beehives. He had to make all the planks and put together all that he wanted to make the box. A neat box, but he had never gone to school. So, the children were wondering how he had all this knowledge. Now in the story it was stated that he had learnt it from other people in Mozambique. So you find that children can apply or use what they had or even copy from someone and then they know something that is not taught at school.*

To show that there is a link between informal knowledge and school science the following teachers agreed that the information learnt at home was not different from that which they taught in science:

> *The science we teach is everywhere because at home even a young child knows that fire burns because of experimentation. And at school we even explain that the heat can burn someone, and anything that produces heat can burn. So I think the science is relevant even at home. But at home we do it unknowingly because even when we wash our clothes and put them on the line. Why put them on the line? It's because we want the water to evaporate, so we are doing science. At home children are told to put clothes on the line so that they dry, and at school we also explain that that is evaporation* **(Grade 5 teacher)**.

> *Yes, science at school is the same as the one at home. Because if you take the subject Trees and Forestry, you have trees, they have trees at home, they breathe oxygen. That is something that they do. And the food, they eat food at home and get nutrients. It's like they need to be aware of what they are doing. We should teach them about proteins here and when they go home they try to, maybe eat food that gives them proteins. If you teach them about food nutrients in general, they will get a better understanding of what they will be eating at home. They can even teach their parents because most of them are illiterate* **(Grade 5 teacher)**.

> *Yes, we try to relate what happens in the home, in the environment and in the school in delivering the topics. Maybe, that's why maybe last time when we were doing that experiment I even gave this example: "Suppose you had salt at home and your young sister or brother mixes it with soil, what would you do?" That was in the last lesson. They had to work it out that you had to dissolve*

> *it and evaporate the water. And there is another way, filtering it again so that they end up having a solution of salt then they evaporate it and end up with salt* **(Grade 7 teacher)**.

What came out of these sentiments was the need to formalize everyday knowledge that students bring to school. The teachers saw a link between formal science and the daily practices of children and their parents. According to these teachers, knowledge that students bring to school as commonsense has relevance to their school science learning experiences and should be transformed to formal knowledge. There is a certain assumption, as suggested in the utterance of one of the teachers, that parents are "illiterate" about the food they eat at home and need their "learned" or "schooled" children to teach them about the importance of a balanced diet. This attitude devalues the rich cultural knowledge that parents have always possessed and practiced. Traditional diet is known to be rich in food nutrients and even Zimbabwean doctors, trained using Western science, advise people to practise traditional eating habits that incorporate traditional foods.

School science and knowledge for future purposes

Some teachers argued that science taught at the primary level should not only be relevant to the current needs of the students or community, but should also prepare students for future careers. For them, the rationale for teaching science to primary school students was in line with long-term future plans. It appears that they perceived current local needs and incorporating local knowledge as being of no benefit to students' future education and careers. The following revealed these sentiments:

> *The science is relevant for their future. There are some things they do not have today but are likely to get in future. For now they might not have electricity, for example, but yaaa…eeem…by and*

> *large a child can appreciate the importance of electricity beside the fact that he has electricity or not. I think to some extent it quite benefits the child, because the child will know that electricity is good in this and that, though he doesn't have electricity at home. Probably, for future purposes the information can help. We are also looking at a child who is probably going to assume a profession, which involves science...we need to teach things that the child will probably use in the future* (**Grade 7 teacher**).
>
> *...we are looking at a child, the whole child who is probably going to be a scientist and who is probably going to take up careers that require knowledge of science. This science we are teaching is just the beginning for the child and it is important to teach important skills now so that later the child does not struggle with the subject...* (**Grade 7 teacher**).

For these teachers, then, education is viewed as a means of preparing young people for the world of adulthood. Thus, formal education is associated with preparation for formal employment and good citizenship. Teachers who saw formal science as a means of preparing students for future careers had these long-term goals in mind. Students were foregoing being taught immediate scientific cultural needs for future happiness. Therefore, the knowledge of science that they were acquiring in primary school was a springboard for future self-development and self-gratification.

The language policy and the teaching and learning of science

Language is a vital component in the teaching and learning of science in rural primary schools in Zimbabwe. It expresses the social and cultural meanings that define social reality. Language originates from and has its primary reference in everyday cultural life. The mother language enables students to express their cultural experiences in the language that they are socialized through and with which they identify. All teachers who took part in this study concurred that in Zimbabwe the medium of instruction used for teaching and learning science is in accordance with the *Zimbabwe Education Act of 1987*, Section 55, which states:

> *(1) Subject to the provisions of this section, the three main languages of Zimbabwe, namely, Shona, Ndebele and English, shall be taught in all primary schools from the first grade as follows-*
>
> *a. Shona and English in all the areas where the mother tongue of the majority of the residents is Shona ; or*
>
> *b. Ndebele and English in all areas where the mother tongue of the majority of the residents is Ndebele.*
>
> *(2) Prior to the fourth grade, either of the languages referred to in paragraph (a) or (b) of subsection (1) may be used as the medium of instruction, depending upon which language is more commonly spoken and better understood by the pupils.*
>
> *(3) From the fourth grade, English shall be the medium of instruction: Provided that Shona or Ndebele shall be taught as subjects on an equal-time-allocation basis as the English language.*
>
> *(4) In areas where minority languages exist, the Minister may authorize the teaching of such languages in primary schools in addition to those specified in subsections (1), (2) and (3)* (Government of Zimbabwe, 1987, p. 225).

The Act gives provision to use indigenous languages to teach science from Grade 1 to Grade 3, thereafter, English becomes the medium of instruction. It is this government policy that ties teachers to the way they use languages in the classroom. The participants in this study were Grade 4 to Grade 7 teachers whose classes were subject to subsection 3 of the Act. It became evident through my observation of their science lessons that English was given priority over indigenous languages. When asked about this some teachers responded in the following ways:

> *I use all languages, Shona and English for them to understand because these kids have problems. They speak Shona so they have problems with understanding English. So if you say something in English you have to repeat it in Shona for them to understand better what you are saying. But it is very important that they should communicate and use English in their learning. Because at times you meet different people of different languages and maybe those people can't understand Shona so you need to speak in English. English is the common language for all the countries* **(Grade 4 teacher)**
>
> *Of course we are supposed to be using English but there are some situations, which would need you to stress the word in its mother language, or the names of the item, you name it in Shona. I explain difficult concepts in Shona* **(Grade 4 teacher)**.
>
> *Our curriculum states that science should be taught in English. But then, these children have very little knowledge of English, maybe, because of [lack of] exposure or something like that. Usually, it's half-half, half-English and half Shona. If you introduce something in English and you find that your pupils do not actually understand what you are saying, you put in some Shona so that they understand, and then from there you go on* **(Grade 5 teacher)**.
>
> *We use the second language, which is of course English. But of course, their level of English is very low. So you may find that if you teach the whole lesson in English very few will benefit. We will then resort to the mother language because what we want here is an understanding of whatever we want to put forward. So sometimes we resort to trying to explain in mother language for understanding* **(Grade 7 teacher)**.

The *Education Act* stipulates that English should be used as the medium of instruction in teaching science from Grade 4 onwards, but as pointed by these teachers, they usually used both English and the mother language, Shona. Although some teachers were observed to be code switching from English to Shona, they held different views on whether the medium of instruction for teaching science in primary schools should be changed. Some had the view that English should be maintained while others felt that an indigenous language should replace English. Those who preferred English to an indigenous language doubted the utility of indigenous languages in teaching science. Some argued that rural students needed practice in the use of English because they had nowhere else to speak it, while others felt that there were no adequate indigenous terms to use in science:

> *...in our rural schools we need to promote the use of English in teaching because they (children) don't have enough English reading materials. So they need to hear the language, talk to each other or to the teacher to improve their spoken English* **(Grade 5 teacher)**.
>
> *Ahh...concerning scientific and technical terms, some terms, yes, they are just very difficult to translate to Shona. For example, "static electricity," what would you call it in Shona? It's just difficult. Otherwise, if we had those terms or people good at translating the terms we would go ahead* **(Grade 7 teacher)**.

Those teachers who advocated the use of indigenous languages were concerned with the limitations a foreign language places on students' self-expression. They were also worried about the disruptive effect that a foreign language has on the home-school connections and on the everyday experiences that their students have. They expressed this doubt in the following statements:

> *I think it would be better for the children and for our society to teach science in Shona because they [students] think in Shona; it's their everyday language. So it's better for them to apply these things [science] in Shona. Although some of the scientific concepts can be difficult, I still think that at least it would be better for their understanding* **(Grade 5 teacher)**.
>
> *Well, I would appreciate it very much, if steps are taken to teach science in Shona. I think that comes again to what we were saying about traditional knowledge. I think for comprehension's sake and understanding, I think we need to do that in the mother language. Concerning [lack of] scientific terms, it is simply because we haven't tried or endeavoured to explore it or to do that. Ehh ... we have been colonized to the extent that we cannot develop our own Shona terms* **(Grade 6 teacher)**.
>
> *I think there must be that link between home and the school. Yes, that is very true because we are saying language is learnt at home and then developed at school. No wonder why in the lesson you saw me teaching I was asking children to speak in Shona. Basically, if you stick to English you will have problems in teaching science. It's always good for them to*

> *use their mother language so that they understand quickly. I think it's best to use Shona when teaching science ... I am saying given the chance to express themselves, they have good points. By using English, you are actually killing others because they are interested in the learning [process]. They want to participate but they are frustrated* **(Grade 7 teacher).**

This Grade 7 teacher provides a strong justification for using the mother language in teaching science. The science curriculum in schools usually ignores the relationship between home and the school. Schooling, curriculum content, teaching and learning styles in most classes run contrary to the social and cultural realities that students bring to the classroom situation. The mother language brings the home-school relationship closer to the experiences of the students. Rural students' ways of thinking are rooted in their indigenous language, the language of the home and the community. As aptly addressed by one of the teachers, using a foreign language such as English "kills" and "frustrates" students. Participation is crucial to self-expression and to sharing experiences. It also strengthens the connection between informal science practiced at home and school science, students and teachers, the home and the classroom, and the community and the school.

When those who supported the use of indigenous languages in teaching science were asked how the problem of scientific terminology would be overcome, the solution they proposed is participatory research involving all stakeholders interested in the scientific development of Zimbabwe:

> *Curriculum developers will have to develop another syllabus, which will cater for that aspect of scientific terms and then we will pick on from there ... You can't have indigenous scientific terms which you can use only at this school. Curriculum is for the nation so they will have to find indigenous words to replace those difficult scientific words so that they become meaningful. I think the curriculum planners should carry out research in everything ... what is in the environment, what the children need to know* **(Grade 5 teacher).**

> *In Tanzania, I understand that Swahili is becoming a national language [medium of instruction], so Shona/Ndebele can also become a medium of*

> *instruction in Zimbabwe. Terms can be developed, but research could be made to find out the words that could be used when teaching science. It [research] should involve all who are interested in the growth of indigenous languages. Elders, traditional healers and others who are users of indigenous knowledge should be consulted* **(Grade 6 teacher)**.

These teachers were confident that with the cooperation between educational planners, policy makers, curriculum developers, academics and members of the indigenous communities, it would be possible to come up with an indigenous vocabulary that was appropriate for pedagogical practices. Dlodlo (1999) argues for the development of indigenous vocabulary so that scientific ideas can be formulated in an African language and from an African perspective. Cooperation and participatory research is the key to the success of this kind of project.

Obstacles to effective incorporation of indigenous knowledge and languages in science

There are problems and hindrances that are encountered when attempting to effectively use and incorporate indigenous languages and knowledge in the teaching of science in primary schools in Zimbabwe. Some of the obstacles are associated with and embedded in the attitudes of teachers, while others have to do with the subtle aims of education as perceived by the teachers, students and parents.

Teachers' attitudes

> In order to address both overt and hidden biases within schools and education we must first address our own personal attitudes, beliefs and behaviours as teachers and administrators. Because we, as school personnel, are strong role models for children we must be particularly aware of our underlying preconceptions of indigenous knowledge or science. To successfully implement a multicultural science curriculum, teachers need to realize and reject their own biases, to be as free of

cultural biases as possible, and to be schooled in cultural awareness. Some teachers in this study doubted and undervalued both the capability and effectiveness of using indigenous knowledge and languages to develop scientific and technical skills that could be applied to scientific principles that can lead to sustainable use of indigenous resources in rural development. In their view, given the globalisation and internationalization of English and "Western" science, indigenous knowledge is retrogressive. Therefore, English is the best medium for sourcing global knowledge necessary for developing advanced skills required for "modern science." They argued too that, whereas English is a tool for international and global communication, African indigenous languages, as well as indigenous science, lack technical knowledge and skills. Indigenous knowledge and languages were thus judged to be culturally specific to African societies only. Some of them had this to say:

> *Hmmm ... of course I use some Shona, and a bit of indigenous knowledge, in my teaching of science but I do not agree with using Shona only in teaching science. English and science are found everywhere in the world, so if I teach science in Shona it will not help students who would like to work in other countries in future. Today people are migrating to different countries, and if I teach indigenous science or Western science in Shona, how will they fit in those countries they will go to work. Indigenous science is for Zimbabweans only and nowhere else is it practiced* (**Grade 5 teacher**).

> *Western science taught in English, as a medium of instruction in science, is okay. It's a common science and English is a common language. Pupils need to express themselves proficiently in English because English is an international language and is also our official language. Science exists across nations and pupils are likely to become scientists so they should learn to express themselves adequately in English using the language appropriate to science* (**Grade 6 teacher**).

> *Indigenous languages are not totally acceptable in the teaching and learning of science. Where are the materials, such as books, written in indigenous languages? There is a possibility that using indigenous languages to teach science faces problems. The main*

> *problem is lack of scientific terms in indigenous languages. It would be difficult for teachers to teach without recourse to an adequate resource of scientific and technical words to use to express the meanings correctly. So let's keep the science we are teaching today in the language that is suitable to it, English* **(Grade 7 teacher)**.

Teachers who provided the above narratives were concerned largely with meeting international recognition through the use of English in science. For them, English and Western science are inseparable, English is the language of science. The rationale for opting for English and Western science was that they have been globalized. The globalization of science and English has meant, in effect, a negation of local science, knowledge and languages. As revealed in the teachers' attitudes, their students were being schooled for the global labour force rather than for local needs. Indigenous science and languages are judged as irrelevant to the understanding of "modern" scientific values and skills that are practiced internationally. Teachers not in favour of incorporating indigenous science and languages in the teaching of school science did not give them status equal to what was regarded as "modern science." The teaching of science was targeted to students who would become, probably, international scientists. Thus, the learning of science was viewed more as an individual enterprise for individual success rather than to meet community needs and societal development. This form of learning lacks African moral values considered essential to the welfare of society (Mungazi, 1996). When children use a language they make little sense of and struggle to be heard and understood, learning becomes a battle and a boring engagement. Students who cannot use English competently are likely to perceive the classroom as "an isolation unit" as they find themselves isolated from the learning situations and experiences. Concerning the students who appeared voiceless, one Grade 7 teacher had this to say:

> *Ahhh ... some of these children are always quiet, reserved and withdrawn. The reasons all depend on individual pupils. Some are individual problems, while others maybe, find it difficult to give out what they have. And some, pupils are dominated by others. That means others get reserved. One other reason is that their answers are easily dismissed by others, so they get reserved because of that.*

The situation described above did not provide equal opportunity to all the students in the classroom. There were some students who took control of the class interaction processes while others were treated as if they did not exist. Unfortunately, half the number of the teachers in the study did not help the situation. Instead of assisting students to put their ideas across in a language they were comfortable with, the teachers created situations that embarrassed the students. If language becomes a barrier to self-expression and self-confidence in the classroom, how will students have the appropriate knowledge, attitudes and skills to lead their communities towards sustainable development?

Science, examinations and the language policy

The *Education Act of 1987*, which classifies English as one of the official languages and also as the medium of instruction in schools in Zimbabwe, creates another obstacle to the use of indigenous languages in teaching science. English has been positioned on a higher language pedestal than all indigenous languages. This has given it official importance that is not accorded to any other language. Teachers are forced by this Act and administrative officials to use English in teaching science:

> *It is our administrators who encourage us and stress that we should use English as a means of communication when teaching science. They state that we should note that policy requires that all teaching in science should be taught in English. But when it's vital you have to put in some Shona words to try to simplify what could be difficult for them* **(Grade 4 teacher)**.

> *According to policy, we usually use English. The government policy is that all subjects, excluding indigenous language subjects, should be taught in English. There are times when you can try to explain in Shona when you want to clarify things for children to understand, but we use English as required by the Ministry of Education* **(Grade 5 teacher)**.

The schooling system in Zimbabwe is geared towards passing national examinations that are vital for students before proceeding to the next level of formal education. At the end of primary education, in Grade 7, students write examinations. The school head proudly referred me to the chart on the wall in his office, which showed the examination performance of the Grade 7 classes every year:

> *If you see from our Grade 7 results, from 1996 we were the best. In 1997 we were the best having at least 2 students with 4 units. Up to last year, 1996, 97, 98, 99 and then 2000 and 2001, but 2002 that's when we didn't do very well. Otherwise of all schools in the district we have been on top.*

So, teachers and the head were concerned more with the passing rate for their classes and the school than with integrating indigenous knowledge and ways of knowing in the teaching and learning of science. They capitulated to the pressure for good results from the school administrators, parents and the Ministry of Education and Culture. The pressure works against the effective use of indigenous languages and the incorporation of indigenous knowledge and science. Thus, at every grade level students were being prepared for examinations, both in terms of content and the appropriate language to use. As such, the curriculum and lessons were confined to knowledge that had been defined by the curriculum planner, the textbook author, the teacher and the examiner; the science knowledge appropriate for passing examinations. The focus and emphasis placed on examinations worked as an obstacle to meaningful incorporation of indigenous knowledge and languages into the teaching of science. In response to my question on the nature of indigenous knowledge that the teacher had incorporated in Grade 6 science lessons, the teacher laughed and went on to say:

> *Examinations won't have indigenous science or knowledge when they come. They test what is set in the syllabus and is in textbooks. Whatever is outside the syllabus will not be tested. So, what is the point of teaching indigenous science if the examiners ignore it? It's difficult to teach indigenous knowledge or use indigenous languages when teaching science until such a time when the syllabus is changed and textbooks rewritten. For the sake of getting good results and covering the syllabus we should, for now, stick to what is there. Sometimes I use a lot of Shona to help children understand some concepts, but when the head or education officers visit my class for supervision, they always criticise me and say that I should use English throughout so that children get used to following the lessons in English.*

When we were discussing the extent to which the teacher incorporated indigenous science and used an indigenous language in teaching science, another Grade 6 teacher expressed sentiments similar to those of the above teacher:

> *We can only use these when the system changes and the Ministry or education administrators agree that examinations can also be answered in local languages. Otherwise because of examinations and lack of appropriate policies and related resources we should let children learn science as it is today.*

The importance with which examinations are viewed makes teachers stick to what is considered factual information; that which is going to be tested at the end of the primary school education level. Examinations did not test indigenous knowledge or indigenous ways of knowing, although school science was not very different from science that is applied in local communities. The differences were found in ways of expressing the knowledge and means of verifying that scientific knowledge.

Material resources and indigenous knowledge

Closely related to the question of examinations was the issue of teaching and learning materials, especially textbooks, which are used by teachers and students as the key source of scientific knowledge that they learn at school. Textbooks validate knowledge, define and determine what is to be learnt and how it is to be learnt. Teachers felt very confident of and comfortable with their teaching when they had textbooks, which they could refer to for information. All the teachers in this study had textbooks, either on their tables or in their hands, to which they constantly referred during the course of their teaching. The practice seemed to have developed into an unconscious one because, when I asked one Grade 5 teacher why she kept a textbook in her hand during the lesson, she was surprised and responded:

> *Ahh! Did I? I am not aware of that. Maybe after writing the work I wanted pupils to focus on I forgot to put it back on the table. But at times you need the textbook to make sure that you are covering all the work for that day. The textbook acts like a guide.*

A Grade 7 teacher kept referring to the text out of a concern to teach students accurate information. Accuracy, according to this view, is what is stated in the textbook. What is in the textbook is accurate, factual and truthful. Thus, the textbook gives fixed "truth" and the teacher has to be careful that children are not misinformed from the start:

> *Well, I refer to the textbook when I am not very sure of the information I am explaining to the pupils. You don't want to give the wrong information. It is not easy to re-teach what you have made pupils to accept and believe to be the right information. So, I have to be accurate the first time.*

Resources such as textbooks are a hindrance to successful integration of indigenous knowledge because they document "facts" and "truths".

Teachers relied on documented information and accepted it as legitimate knowledge. They tended to focus on what was already prescribed as scientific knowledge. The assumption was that children had to be guided towards what the teachers had gleaned from books as knowledge worth learning. As a result of this assumption, usually teachers did not deviate from what was presented in textbooks as knowledge. When they were asked about the indigenous knowledge in the *Environmental Science* textbook that they used, teachers did not think that there was much:

> *Some little everyday knowledge, there is not much indigenous [knowledge] in it* **(Grade 4 teacher)**.
>
> *Maybe one tenth [of what is in the textbook]* **(Grade 5 teacher)**.
>
> *There are no science books that have indigenous science or written in Shona* **(Grade 7 teacher)**.

Textbooks were a major source of science knowledge for the teachers and students. It was what was in the syllabus and textbooks that was examined and therefore worth teaching. As observed in the teaching techniques used by teachers, information and questions were taken from textbooks and teachers used these for instruction. Students were not taken as social actors who are capable of initiating and creating knowledge. The stories and experiences that they brought from home and their communities to the learning situation were overshadowed by the need to fulfill the demands of the syllabus leading to the passing of examinations. It appeared that school science and the teaching of science were primarily targeted at passing examinations and not at its usefulness to the immediate community and the needs of the social environment of the students. As a result, teachers made very little reference to the local indigenous knowledge in their teaching. When I observed them teach, I did not get much of the student's voice. The lessons were primarily question and answer sessions that were intended to reveal how much the students had internalized the "factual" knowledge that was presented by the teacher. Science teaching in these classes ignored what Edwards and Alldred (2000) describe as the socially patterned experiences and the social processes that are concretely lived and negotiated. Some of the lived experiences may not have appeared in the science syllabus or in examination questions, but they were vital in assisting and enhancing students' understanding of school science. Learning is not only about passing examinations but also to help students make sense of their physical, social and spiritual world. In other words, it is about improving their lives.

Because teachers focused more on teaching "facts" than making learners understand science using their experiences and realities, they usually overcrowded these "facts" in their teaching. This ended up confusing students. Experiences that form the students' representations of the world of science were not utilised to connect students to school science, hence denying students the opportunity to cross cultural borders. A Grade 7 teacher I observed teaching a lesson on "Map Reading-Lines of Longitude and Latitude," later, during our discussion, pointed out that the lesson was very difficult and boring to teach. In the words of this teacher:

> *That lesson was boring. It appears the matter was abstract and too much for the children. Instead I could have only ended the lesson on identifying the Lines of Latitude and the Lines of Longitude. The other part of identifying places on the map could have been another lesson because it appeared too much for the children and I remember they failed to find some of the places I thought could be easily found.*

Throughout the lesson the teacher had been preoccupied with delivering factual knowledge. The daily experiences of students were not made use of. Rural children know how to identify places using landmarks and the sun to tell directions. This is their everyday knowledge that they regularly use to understand the movements of their livestock and when visiting distant neighbourhoods. It is part of their community knowledge. This knowledge could have been made the foundation for linking indigenous knowledge to the lesson on Maps, which the teacher was conducting. Students in rural Zimbabwe have many stories that involve map reading and directions. It is possible that some of them could have got lost occasionally because of failure to remember directions. These are the voices that were ignored that could have helped both the teacher and the students. As Dei (1996) argues, people's ways of thinking and knowing are rooted in their indigenous lives. If the teacher had embedded the lesson in student's experiences and ways of knowing, probably, the lesson could have been better understood by the students. What was required was a fusion of various forms of knowledge.

Science and teacher training

The methods employed and attitudes that teachers hold towards the teaching of science derive partly from their pre-service training at teachers' colleges. It would appear from the comments of teachers in this study that teacher preparation and courses they took at teachers' colleges do not incorporate indigenous knowledge or science in their science curriculum or in pedagogical practices. A student teacher in one of the Grade 4 classes I visited confirmed that there was no indigenous science in teacher education curriculum. According to the file this student teacher had, the following were stated as the criteria used by the college for selecting science content:

a. *Wherever facts are presented they should be discoverable by the student.*
b. *Facts selected should be of critical importance to understanding of a scientific principle*
c. *Content should help to show how science proceeds through a method of discovery.*

d. It must be cheap to do, cheap to find out, economical in time as well as money.

The criteria set out above indicate a paucity of localization and indigenisation in the science that student teachers are taught in colleges in Zimbabwe. The content and expectations of students in teaching science lack indigenous African perspectives. Although the majority of student teachers end up teaching in rural schools after completing their training, it appeared that they were not trained and prepared to interpret and teach science in a culturally sensitive manner. What is of particular interest in the above statements is the way "knowledge" that was presented in the curriculum and to be discovered by students was described as "facts." What could be questioned is **who** defines and **how** is the information defined as **"facts?"** The teacher education curriculum seemed to provide no room for relativism of knowledge or facts. Does indigenous knowledge or science fall into the same category as "facts?" and, does the curriculum give space for the discovery of indigenous knowledge in relation to school science? When I inquired into how much indigenous science the lecturers in teachers' colleges brought into their lectures, tutorials and seminars, the student teacher replied that there was not much, if any:

> *No, they just talk about the science that is found in books and taught in schools. They just say that you must use the environment as your lab. They say don't teach science in the classroom. You have to go out and teach outside the classroom. But they don't say anything about indigenous knowledge.*

It is what happens in the lecture theatres in teachers' colleges that influences to a great extent what will happen in the classroom when student teachers eventually complete their training. To disregard cultural fusion in the science program in teacher education denies teachers the skills and techniques for successfully incorporating indigenous science in formal science. Advising student teachers to use the environment as their classrooms without relating teaching and learning to the social and cultural environments of students undermines any effort aimed at knowledge harmonization and hybridization. That advice will not help much in making teacher trainees become cultural brokers and cross-cultural teachers. It is the responsibility of teachers' colleges to cultivate a change of attitude in teachers such that they are more favorable towards indigenous knowledge and amenable to relating it to school science.

Summary

In this chapter I have presented findings from classroom observations, interviews/ conversations with teachers, as well as data collected from documents and posters used by the teachers. The findings are presented in the form of narratives from participants and extracts from documents. The next chapter focuses on conclusions and policy recommendations derived from the study findings. The conclusions should not be regarded as generalizations, but should be considered within the specific site context and specific cases of the study.

CHAPTER VI

CONCLUSIONS AND POLICY RECOMMENDATIONS

Introduction

This chapter presents and discusses the conclusions that were derived from the findings of this case study. These conclusions are not to be generalized to all primary school teachers in Zimbabwe. The intention of this qualitative case study was not to collect data that represented all primary school teachers who teach science in Zimbabwe, but to gain insights into the attitudes, views and experiences of the ten teachers who participated in the study. Therefore, the study collected voices and insights of teachers in one school that I visited in rural Zimbabwe. Since this research is a qualitative-constructivist case study of teachers in one rural primary school, the conclusions are specific to these teachers' experiences, attitudes and views on using indigenous knowledge in teaching science in their school. However, because of the similar social and cultural settings in which rural schools are located, what was found with respect to the teachers in this case study could, arguably, be also applicable to other rural primary school teachers who teach science. Nevertheless, such conclusions would have to be supported or verified through further research. This chapter also makes some recommendations that could be implemented as policy to promote and enhance the incorporation of indigenous knowledge in the science program in Zimbabwe's primary schools.

CONCLUSIONS

These conclusions are on my interpretation of the dialogues I had with teachers and on my observations of their teaching of science. They were also arrived at through close scrutiny of the primary school science syllabus as well as the science texts and posters displayed in the classrooms and other learning/teaching aids that were used in the science lessons. The conclusions are presented in sections in order to address in an orderly fashion the research questions posed in Chapter 1.

Indigenous knowledge/science or Western science in primary schools

Western and indigenous knowledge in Zimbabwe are in a state of continuous flux and contestation resulting from teachers' perceptions of the concept "science". The binary opposition between the two forms of knowledge seems to allocate power to the cultural meanings associated with Western knowledge and these cultural meanings are perceived as school or academic knowledge. Western and indigenous forms of knowledge in this opposition are not given equal respect; they are not valued equally nor are treated equally. The first form is considered superior while the latter is defined as derivative, undesirable, and subordinate. A common feature of the 'science' that was taught by the teachers in this study is the 'natural' or 'physical' knowledge domain. The science knowledge taught revolves around 'nature' or the physical environment. Although some of the teachers pointed out that the knowledge of science they taught interacted with the human aspect, it was largely confined to how people manipulate the environment. What was not clear in their conceptions of science is how the environment is used to bring about sustainable development in society, or how people interact as social and cultural agents to make use of their environment for sustainable human development in health, agriculture and livestock management. Science was typically perceived as a subject involving for the most part an investigation into the "truth" of knowledge, and manipulation and experimentation with nature. But what children experience in their daily lives is practical science, not abstractions. They experience science in their interactions as they seek explanations of their social and cultural lives. These daily experiences, however, were largely ignored in the teaching of science in most of the classes I observed. From the explanations or conceptions of science provided by teachers in this study, it became apparent that their understanding of science involves objective reality, whose philosophical position is grounded in empiricism, which views science as neutral, absolute and objective. This conception falls short of the holistic and interconnectedness that represents the indigenous people's life, which is embedded in their social, spiritual and physical environment.

While it was difficult for these ten teachers to say with certainty what constitutes indigenous knowledge, there were some who were confident that science in schools is purely Western and this was the science that they taught. They had a tendency to stereotype indigenous knowledge that students brought into the classroom as "traditional" and "backward". They felt that traditional science was retrogressive, unauthentic, and unreliable since it could not be verified by scientific methods. By scientific methods, they implied the empirical verification of "truth" using experiments. These teachers believed that Western science was taught in schools and was verifiably absolute. What was interesting with all the teachers, whether they accepted or objected to the inclusion of indigenous knowledge in their teaching, was that they saw students' home and community knowledge, not as a body of scientific knowledge, but as a "lead-in" or starting off point for their lessons. They justified this approach by citing the teaching principle of "starting from the simple to the complex, the known to the unknown." In this case the simple or known was the home knowledge the students brought to school, and the unknown was the "Western" science that was taught as school science. When students used traditional beliefs, values and customs to explain "scientific" principles, these frequently were not accepted as science but rather deemed myths and tales.

Although some of these teachers pointed out that there is no distinction between indigenous science and school science, the content of science they taught and their teaching methods were embedded in Western scientific principles of proof and evidence. In their classes teaching of science emphasized the provision of evidence that guided students to discovering pre-determined "facts." Teachers were not comfortable with accepting the truthfulness of indigenous knowledge, and when it happened to be brought into the teaching and learning process, what they saw as their role was to "correct the wrong beliefs" and inculcate "the right scientific thinking and attitudes". The examination system that requires students to reproduce material that they learn in science forces teachers to "correct" these "wrong beliefs." In Zimbabwe it is the number of students who pass examinations with "good" grades that constitute the prominent measure of the effectiveness of teachers' performance. Hence teachers are reluctant to incorporate traditional knowledge into their teaching of science. Knowledge construction and teachers in postcolonial states should, in fact, search to demystify Western thought and exert considerable critical effort towards undermining the hierarchical dualities that occupy a supreme place in Western culture. Rescripting and demythicizing colonial knowledge entails debunking the same knowledge and its associated worldview. It means deconstructing Western knowledge, which is regarded as the most valid and legitimate worldview for effective and meaningful social change in Zimbabwe.

Indigenous cultural capital in the science curriculum

The acceptance of cultural knowledge and cultural differences leads to flexibility and innovation necessary for effective teaching and efficient learning. Learning becomes a meaningful engagement if it takes account of the learners' habitus (Bourdieu, 1984). Ironically, in the teaching and learning of science in primary schools in Zimbabwe, it is still the cultural capital of the white middle-class colonizers that forms the core of the science curriculum. Whether students are learning about Energy and Fuels, or Materials and Technology, the approach to these topics resembles those that were followed in colonial school classes. Teachers emphasized methods that sought to promote the acceptance of some body of knowledge as truth while that which did not meet "scientific criteria" was rejected. As noted in de Castell (1993), some students' stories are considered to disrupt expected educational narratives. They are viewed as not fitting within the educational narratives of "scientific" discourse. Thus, indigenous stories that are embedded in indigenous beliefs and values are regarded as going against the grain of educational expectations. Therefore, students have to have their cultural capital from home transformed, changed and corrected because it does not meet acceptable scientific explanations.

Because teachers perceived themselves as purveyors of new, authentic and reliable scientific knowledge, they believed that one of their roles is that of changing the faulty traditional beliefs of parents and students whose subculture promotes retrogression. These teachers represent the positivist approach to teaching, and in the process reject the approach that views children and parents as co-constructors of science knowledge. They adopt an anti-post-modernist perspective that promotes power and specificity of some forms of knowledge. According to their views, rural students lack positive attitudes and are deprived of enriching experiences because they are not couriers of "modern" and Western culture. As observed in most of the classes visited during my research, the indigenous culture and the social class of children in rural classrooms vary and are often at "odds" with the culture of the school.

Teachers did not adequately address the relevance of the students' cultural lives in their teaching. Their teaching was far removed from Giroux's (1992) transformative teaching and learning pedagogy that engages teachers and students in a reflective, dialogical, open and critical way of thinking about school science and how it relates to the students' lives. Mutual respect and acceptance of the importance of students' cultures were largely absent. Teachers tended to distance themselves from constructing science knowledge from a constructivist approach as they saw this approach as a danger to the classroom discourse, institutional culture and the traditional politics of schooling. de Castell's (1993, p.185) conclusion that constructivism in the classroom opens doors to "meeting new challenges... {that}...accommodate differences," thus leading to the "narrative of redemption" seems to be overlooked. Knowledge of school science, as defined by the teachers who legitimated it, gave the teachers social power to control classroom activities and the power to validate knowledge that was already prescribed as science by the syllabus and textbooks.

The importance of incorporating the cultural capital of rural students into the teaching of science was perceived by the teachers as trivial and irrelevant. The need to follow prescribed knowledge that was to be tested to measure the performance of students and teachers appeared to have a disenfranchising and disempowering effect on students. It denied the teachers and students the opportunity to link cultural knowledge to formal science; a process that is vital to students' understanding of school science. Because the curriculum stipulates what the teacher should focus on in science, Freire's (1985) advice on offering liberatory and empowering pedagogical practices that rupture conventional adherence to traditional pedagogy that oppresses and imprisons students is not fully followed. Students attend school with different cultural identities, beliefs and values. They are socialized in circumstances and experiences that may limit or enhance their learning situations. Incorporating indigenous cultural science into formal education is one way to respond to the call in Zimbabwe for greater sensitivity to cultural difference and to improve access to science education for all students. Regrettably, as Shepard and Harold (1995) point out, the general reaction of teachers in Zimbabwe to the problem of underachievement, alienation and withdrawal as it relates to cultural diversity and difference has been to focus the "blame" for "failure" on the rural culture and children themselves.

The teachers who participated in this study need to re-examine their biases and be schooled in multicultural education. Teachers in rural schools should realize that failure to address students' cultural anxiety exacerbated by teaching methods and techniques that do not accommodate cultural differences are in part responsible for their students' "failure" and "underachievement" in science. A new middle class in Zimbabwe has appropriated the colonial middle-class cultural capital that prevails in the teaching of primary school science. The new middle class that controls and legitimates knowledge is the new black middle-class, and their interests are largely those of the colonial white middle-class who were their predecessors. This class now controls the education system and resists any attempt to incorporate indigenous knowledge in the teaching and learning of science because they believe this will lead inexorably to the lowering of educational standards. Some civil servants, who are supposed to implement government policy, managers and other professional groups, have voiced their disagreement towards transforming the science program in Zimbabwe.

Disenfranchising effect of science teaching

Whereas indigenous perspectives on teaching and learning science are intended to commit rural schools in Zimbabwe to assist students embark on liberatory, empowering and equitable educational engagement, at least some of their teachers actually regard such perspectives as retrogressive and forms of ignorance. Indigenous perspectives on science are, purportedly, perceived as not relevant and conducive to current developmental needs. Rather, they are regarded as obstacles to the acquisition of "scientific" skills and attitudes. As de Castell (1993, p.186) argues:

> Education remains a field of discourse governed by obligation to "be positive" and in which, increasingly, no one dares to speak of obstacles, impediments, and difficulties without in the same breath expounding on "solutions." The categorical imperative to remain "positive" at all costs reigns here, even at the cost of willful blindness, misrepresentation, and a kind of "*studied* ignorance" which cannot be other than intentional.

For some rural primary school teachers, the obligation to "be positive" is seen in the way they reify Western science as global knowledge which is a "must" for students. It is accorded more power and status than indigenous science. It is by means of this strong bias in favor of Western science that the science discourse expounded in the four walls of rural schools remains alien and far removed from the realities of developmental needs of the local people and their communities. Indigenous episteme and epistemologies, within the politics of knowledge and schooling, are seen as obstacles and difficulties to be avoided. Ironically, the reproduction of Western science and the misrecognition and misrepresentation of indigenous science continues in spite of the fact that the science curriculum is planned, designed and implemented mostly by indigenous policy makers and academics. Cross-cultural science is thus being sacrificed for what is perceived to be logical, progressive and global. Scientific knowledge, moreover, whether Western or indigenous, is being taken for granted and not ordinarily open to interrogation. Students who are channelled to study science using a tunnel vision are denied the opportunity to develop critical and independent thinking, and new insights from diverse cultural experiences.

Teaching strategies and ways of knowing students are being exposed to, invariably trivialize the collective experiences of rural students and those of their parents. The political terrain of schooling promotes the scientific worldview of *others,* a worldview that is external to the experiences of Zimbabwean rural students. In partially denying their experiences, beliefs and cultural traditions, the school science program in effect attempts to erase other social, cultural and historical memories that are vital in determining the developmental needs of local communities. Though worldwide indigenous knowledge is widely accepted as an important tool for the development of indigenous communities (von Liebenstein, 2000), schooling practices continue to promote and perpetuate power and struggles over the two forms of sciences (Western and indigenous). Those policy makers, teachers and academics who were schooled under colonial education systems continue to overvalue the importance of Western science at the expense of indigenous knowledge. Mohanty (1990, p.184) puts it thus:

> [E]ducation represents both a struggle for meaning and a struggle over power relations. [It is] a central terrain where power and politics operate out of the lived culture of individuals and groups situated in asymmetrical social and political positions.

Rural people in Zimbabwe have the needs of their children's schooling defined by those with political power, those who control political decisions and those who have been assimilated into a culture different from theirs through enculturation. The teaching of science in rural primary schools seems to be far from consciousness-raising, as it represents, to a large extent, a monolithic position. Regardless of themselves belonging to the indigenous groups in Zimbabwe, teachers do not seem to make attempts to extricate themselves from the dominant perspective of school science. They do not make attempts to break the conspiracy of silence and marginalization by promoting indigenous scientific perspectives but rather appear to facilitate and ensure the perpetuation of their marginalization and exclusion.

Culturally-sensitive science curriculum

The education policy in Zimbabwe does not explicitly prescribe the position and role of indigenous knowledge in the primary school science curriculum. There is no official policy requiring the inclusion of indigenous knowledge in the science program in primary schools in Zimbabwe. Therefore, I observed that where teachers were making reference to indigenous knowledge, they did so not in a planned manner but rather informally. Neither was it in the content of the textbooks. It was brought into teaching process by way of examples used by teachers or questions raised by students. When reference was made to indigenous knowledge and ways of explaining everyday African cultural reality and experiences, though these teachers reluctantly accepted the existence of beliefs and values associated with cultural knowledge, they were prone to dismissing the knowledge as neither useful nor scientific and used "Western" ways of knowing to discredit indigenous knowledge as not valid and reliable. Nevertheless, there were one or two teachers who attempted to link science to the everyday experiences of students, although they were using these experiences to validate Western science in schools. For these teachers, students' experiences were crucial in helping them to cross cultural borders in science and to make their learning meaningful.

On those occasions when students cited family and community cultural beliefs to explain their experiences with indigenous science, one or two teachers in upper classes treated this knowledge with indifference. As Thaman (2001) observed in the Pacific Islands, such teachers are often insensitive to the needs and difficulties of students. These are teachers whom Semali and Kincheloe (1999) described as "academic gatekeepers" who use the rules of evidence (empiricism) and the dominant epistemologies of Western knowledge production to deem an understanding of non-Western knowledge irrelevant. Teachers in this category followed pedagogical practices that lacked continuity with rural children's experiences. In their quest to teach evidence or proof-based science, they rejected alternative multiple forms that their students brought into the learning situation. Instead, they promoted discontinuities between students' home experiences, cultural knowledge and the traditions and practices of formal schooling.

In India, Sarangapani (2003) also noted that insensitivity to students' cultural knowledge caused a cultural gap between home experiences and school science. In rural primary schools in Zimbabwe, teachers have unconsciously experienced the silencing effect brought on by a lack of cultural congruency and contradiction between their students' home culture and the world of school science. But they are doing very little to alleviate this educational problem. The insensitivity of some of teachers in this study can be attributed to the curriculum and syllabus, since these do not give guidance in ways of incorporating students' experiences and cultural backgrounds. Accordingly, the curriculum needs to be redesigned to make it relevant to multiple science realities that exist in the classrooms.

Multicultural science

The education policy and science curriculum for primary school science largely neglects the cultural diversity that prevails in Zimbabwe. A perusal of the policy and syllabus documents revealed the absence of a recognized presence of difference and diversity in society. The science syllabus encourages "a hands-on process approach" to teaching science (Curriculum Development Unit, 1994, p. v), which takes into consideration *experimentation, simulation, field trips, demonstration, project method, case study, resource method* and *problem solving*. Although these strategies suggested are vital in inculcating "scientific" thinking and reasoning, the syllabus did not describe the social and cultural context in which these methods should also be applied. The strategies seem grounded in constructivist philosophy, which encourages students to make their own discoveries of "knowledge." But what was doubtful was the extent to which the students' social, cultural and historical experiences would be made use of. Were the strategies to be applied to the exploration of the physical environment and its relationship with the social and cultural experiences of the local people? To what extent would they be context specific? The teaching techniques were likely to create an impression in students that knowledge or science was objective, absolute, value-free and fixed. Teachers who adopted these teaching methods were effectively promoting the hegemony of one form of science over others.

It is the social and cultural context that offers space for employing multicultural science. Ignoring familial and community cultural settings promotes assumptions that Western "science" is superior to indigenous knowledge found in families and communities surrounding the school. One should question the relevance of some instructional methods used to teach science in rural schools, if they are not deliberately linked to community life. Taking their cue from the policy and syllabus documents, teachers also tended to ignore the diversity that exists in science.

The pedagogical practices of the rural teachers who participated in this study are centered on the "deficit model approach" (Bruckerhoff, 1995), which is based on the assumption that rural families fail to provide the skills, resources, attitudes and motivation necessary to prepare their children for science in schools. Thus, they focus their teaching of science on developing scientific skills and attitudes necessary for scientific exploration (Curriculum Development Unit, 1994). However, the impact on relevance and link of this scientific exploration to the community appeared not to be considered by what went on in the classroom. Cross-cultural knowledge, the bedrock of multicultural science, requires teachers with vision and insight into the cultural differences of students.

Some teachers in this study appeared to lack the vision and insight to act as cultural facilitators, cultural mediators and cultural brokers. They seemed to lack the ability to minimize the polarity that tends to exist between school science and cultural sciences. The teachers did not create adequate space for home and community knowledge in their teaching of science. Teachers also seldom used students' narratives and stories, which could have served as a bridge to enhance cultural adaptation to the new culture of school science. A successful science programme should be designed around students' unique learning strengths grounded on multiple cultural experiences. The effort of teachers who attempt to effect knowledge hybridization by incorporating students' home and community experiences should be complemented by a science curriculum that gives credit to multiculturalism as a teaching and learning philosophy.

The question of the relevance of science material

In this case study, the teaching materials that were used in the school to teach science were largely that which came from the local environment. Students brought the material to the classroom or they went out to collect it during the course of the lesson. The materials that students brought were usually familiar to them and did not cost money. The material could also be described as relevant and appropriate to local needs. Teachers also prepared some of the materials in the form of charts and drawings on the chalkboard. Usually, the drawings represented what could not be physically brought into the classroom, for instance, a beehive, which was drawn on the chalkboard by a Grade 4 teacher. Nevertheless, some of the material was commercially procured such as that which was used in one Grade 5 classroom. The teacher was teaching a lesson on *reflection* and *images* and had to bring "curved mirrors" to teach the concepts. In addition, though there was also a science kit from the Ministry of Education, Sport and Culture, no teacher in my study used it. Thus, the material that was used by the teachers of science in the school ranged from that which seemed locally appropriate to that which was modified in an attempt to suit the educational needs of the students.

However efficiently curriculum producers manage to develop materials for teaching science, the effectiveness of the materials will still be in strict proportion to their relevance to the educational, social and cultural context in which they are being used. What is needed in rural primary schools, alongside materials nationally designed and prescribed, is locally produced material to suit local needs and accommodate diversity in social and cultural contexts and needs. Locally produced materials take into consideration the local histories of the communities.

while nationally produced materials can be modified and enriched to suit local conditions. In the classes I visited, the materials brought by students seemed to work very well, and the charts and diagrams drawn by teachers played their part in enhancing the students' understanding. Unfortunately, the science kit seemed unpopular with teachers because none of them used it.

It is educationally sound to involve students in deciding on materials that can be used in science lessons. Besides empowering the students, it also gives them the opportunity to choose material that is relevant to their learning and meaningful to their experiences. Teacher or student-produced material and the use of the environment do not only save money but also makes locally produced material culturally sensitive. For example, students know types of trees that should not be cut down because of the trees' cultural and ceremonial significance. This knowledge students acquire from elders in the community is relevant and important in learning environmental science and the management of the environment for sustainable development.

Validating and legitimating indigenous knowledge

The validation and legitimation of indigenous knowledge in school science in Zimbabwe is an educational issue that is contested and contentious. The status given to any form of knowledge depends on how the knowledge is judged by those people who are responsible for formalizing it. As Sundar (2002) points out, whether a body of knowledge is deemed "indigenous" or formal and is valorized and incorporated into the formal education system (which then certifies it as "legitimate knowledge") depends on the status and power of the social group judging it. In Zimbabwe, indigenous status is accorded to people on the basis of a political and racial definition. Only blacks born of Zimbabwean parents are regarded as indigenous. However, when it comes to indigenous culture, people have failed to give an appropriate definition to the concept. As a result, when talking about indigenous culture, reference is usually made to beliefs, traditions, customs, norms and values governing social life in rural areas of Zimbabwe.

However, as Sundar (2002) observes, the distinction between "indigenous" and "non-indigenous" is particularly invidious when it comes to knowledge. Those who have power define school science for the majority of the people. Rural people are marginalized and "powerless" to see that important and worthwhile knowledge for their children and for their livelihood is taught in schools. Educational policies are made on behalf of rural people usually by people who know little about rural people's cultural lives and needs.

Educational policies regarding the indigenisation of school curriculum are rooted in the social and economic power of knowledge. In Zimbabwe, it is a strong belief among policy makers that indigenous knowledge is vital for sustainable development and economic growth. Therefore, economic concerns, and concern for international competitiveness, may be taken to mean that the efforts of the educational system should be geared much more towards what is thought to develop economically productive individuals. More than before, students may be seen as instruments for the promotion of the national economy, rather than as individuals whose growth potential as human beings should be developed in its own right within the social and cultural environment they are familiar with. One may even argue that many of the current features of primary school science in Zimbabwe are better adapted to the needs of colonial society.

Questions of schooling – funding, organization, and curriculum – are contested, because they are at the heart of national identity. Current education policy in Zimbabwe indicates that politicians and educational administrators have a monopoly over what is regarded as what is worth knowing. This control is derived from educational legislation that is then translated into the curriculum and school syllabuses. Unfortunately, where educational policy does not explicitly state the intention to Africanize or indigenise science, professionals, such as teachers, get confused and will therefore approach the teaching of science differently, as indicated by the experiences of rural primary school teachers in my study in Zimbabwe. Teachers, as curriculum implementers, were at the mercy of educational administrators and had no voice in deciding what was worthy knowledge. What they taught was laid down in the curriculum and syllabus and the teachers had very little control over what was examined as appropriate scientific knowledge. Hence, they played at best a minor role in legitimating and validating indigenous knowledge and incorporating it in school science.

There were those teachers who advocated for the current position whereby Western empirical knowledge remains at the heart of school science currently practiced in Zimbabwe. As discussed earlier on, legislators, policy makers, educational administrators, teachers, and parents too, prefer Western science to indigenous knowledge and want Western science to remain prominent. Teachers in this study argued that knowledge globalization is a reality that makes indigenous knowledge irrelevant to school practices. They further argued that the transfer of knowledge from developed nations to less developed nations makes the teaching of Western science vital and that scientific attitudes should constitute the foundation of primary school science. They argued that social and economic growth was sustained by tested and verifiable knowledge, which had been successfully applied in developed nations.

Globalization from above seems to be what these teachers were advocating for and conceding to. Thus, "verifiable knowledge" should be given priority in school science in Zimbabwean primary schools. These Afrosceptics of indigenous science and their claims against its incorporation in school science, prejudices and continues to marginalize these forms of knowledge and ways of knowing. Education, in the current global context is inevitably a key site of struggle. So long as indigenous knowledge is associated with negative perceptions, it will be difficult for policy makers and teachers to accept it as valid and legitimate knowledge. It is these professionals who have the power to control knowledge who have to change their attitudes towards diverse forms of knowledge.

What is encouraging, however, is the finding that there are teachers who viewed cultural knowledge positively and used indigenous knowledge in science to make their teaching culturally sensitive. They did this unconsciously, and in the process they covertly imparted attitudes and scientific ways of thinking that were indigenous and African. Contrary to teachers who showed disrespect for indigenous practices in science, these teachers accommodated them in their teaching because they felt that there was a link between what was practised at home and taught at school. For instance, the use of medicinal herbs at home was important in what the teachers taught in *Health and Pollution*. These teachers viewed the link between home knowledge and school science as legitimate and important because the formal content of the school science had to be rooted in something that students were familiar with. By incorporating familiar knowledge, the teachers were creating enabling learning environments in which students' memory from home and the community was being translated into more "useful knowledge" for understanding and interpreting school science.

Knowledge is not legitimated and validated only by those who plan what is to be taught in schools, but also by those who decide how to teach it. Thus, teachers have a great responsibility to teach inclusive knowledge and validate formerly marginalized knowledge. In this way, teachers can break the binaries between indigenous science and school science. When binaries are broken teachers will then be able to confidently argue:

> *"There is no way I may teach Western science without traditional science because it is one and the same thing"* **(Grade 6 teacher)**.

Binaries tend to allocate power to one form of knowledge while undermining the other. We need teachers whose training is not primarily aimed at imparting science in the form of established factual knowledge, but rather at understanding children and their society, and children's interpretations of the formal and informal messages emanating from the teachers and the schools. Teachers should learn to be facilitators of individual growth, making full use of the fundamental educational potential offered by interaction between the schools and the children's homes and communities. Learning to live and interact with other people from different backgrounds, different abilities and different norms and values, should be an essential part of the science learning process for all students in Zimbabwe. Teachers should not emphasize the conventional approach to teaching that focuses on factual science. This may act as a poor and narrow straightjacket that limits students' understanding and creativity.

Parental spaces and voices in teaching science

Ideas underpinning multicultural science and cultural sensitivity are in harmony with parental involvement in promoting dynamic, flexible and cross-cultural classrooms that are free from intellectual hegemony. Knowledge validation and cultural legitimization are a struggle that involves many interest groups. Parents are included among these groups whose interests should be considered if the science curriculum is to disseminate messages and practices that are relevant to community development. The teaching and learning of science has to present multiple visions of legitimized socio-cultural worlds. The inclusion of parents in their children's classes debunks and demystifies the myth that science is associated with "modernity," and "modernity" is what schools teach. The teachers in my study, unfortunately, did not involve parents of students in their teaching programs. They did not invite parents to their classes to assist in science lessons. Even the head teacher agreed that they had not done enough to encourage parents to be part of their teaching programs. It appeared as if teachers saw the classroom as *their* professionally defined social space and parents as outsiders.

When parents are sidelined in the teaching and learning activities of their children they feel helpless and incompetent, whereas a strong parental involvement transforms them into a vital source of science information. It gives them the capacity to make meaningful contributions to their children's school lives. In the case of the school in which I carried out my case study, the absence of parental space and voices belittles their important role as the initial teachers of their children. The presence of parents in the school is welcomed mainly on *"prize giving day, open day, and when parents come to pay fees or when called by the head, or when they come to make complaints about teachers"* **(Grade 4 teacher)**. From my discussions with the school head and teachers, it emerged there was very little communication between the teachers and parents. The school personnel rarely invited parents to contribute to the official curriculum to enhance their children's learning outcomes. Vertical communication seemed to flow in one direction, from the school to parents and not vice versa. Swick (1991), cited in Shepard and Harold (1995, p. 375), summarises the impact of such communication:

> Far too often teachers use a directed, authority-based form of communication with parents. While such a form of communication is ineffective with parents in general, it is disastrous with at-risk parents [**rural parents**]. Highly formal, authoritative communication too often lacks the two major components vital to involving at-risk parents [**rural parents**] in meaningful partnerships: closeness and mutuality…closeness that exists in responsive, supportive, and sensitive communication. They also need a feeling of mutuality, a sense of togetherness with significant others as they attempt to resolve problems….

The school needed to establish a close and, if possible, an equal partnership with the community. Sharing of knowledge between teachers, students and parents equips teachers with the tools to manage their professional lives, while parents and students will be empowered to effectively control and manage their environment for the benefit of their communities. The hybrid of knowledge derived from the partnership is capable of transforming the teacher, the student and the parent. Ironically, teachers, in my study, though they did not openly say so, seemed to have negative attitudes toward parental involvement. Only parents who were considered to be experts and able to contribute towards technical knowledge in science were likely to be invited to the teachers' classroom. These negative attitudes tended to subvert the empowerment process. It was through mutual respect for each other's knowledge that teachers and parents, schools and homes, can become centers of meaningful and empowering learning for students. Multiple spaces and voices in the classrooms contribute to learners who develop empowering approaches to solving problems.

Multiple perspectives in the teaching of science empower students to approach personal, familial and community problems with confidence and vision. Students who are empowered by multiple perspectives in science are capable of:

a. Making effective use of their environmental resources, hence improving social conditions and livelihoods, while at the same time applying "science" to manage their environment.

b. Being effective problem-solvers who apply cultural, social and economic realities that exist in their communities.

c. Having productive interactions with others using skills and attitudes acquired through experiencing a cross-cultural hybridity of school science.

For teachers to facilitate and enhance the abilities of an empowered student they should recognize, accept and appreciate the important role of the parent as the principal educator of the child, and as a respected partner within the science-learning environment. As Bruckerhoff (1995) points out,

> The family provides the basic elements for cultural and social being, a child's first and formative education in local knowledge – a soul. The health of the family is essential for the well being of individual children, therefore society. Public education in a democratic society is the formal, institutional means for all children to gain understanding and appreciation of the family in its relationship with the local community and, ultimately, the complex cultural heritage.

Teachers should desist from demonizing and stereotyping indigenous knowledge as "backward" and reject the view that they *"must always try to change those beliefs"* from home and the community. They should view and consider parents as the "best experts" and a valued source of information in teaching science. As hooks (1994) points out, parents own collective memories: cross-cultural texts and images, which are in essence appropriate to science pluralism and learning.

The language problem

Teachers in this study reported that the main problem they faced in teaching science was that students seemed to fear talking to them or responding to questions. They pointed out that some students never spoke or contributed to the learning process. Hence they appeared reserved and withdrawn. The behaviour manifested by these students could be explained in terms of the distance and polarity that exists between home language and the language of science instruction at school. While I observed that students freely communicated with each other in their home language during group discussions, this freedom and relaxed atmosphere was absent during class discussions or when the teachers wanted the students to respond to questions in English. The use of English appeared to have an alienating effect, it "killed" the students' desire to participate and engage effectively in the learning process. The English linguistic hegemony thus increased the gap between students' experiences and the experiences that teachers intended the students to acquire.

Language originates in and has its primary reference to everyday life, and this language is invariably the mother language of the speaker. As Berger and Luckmann (1967) observe, language is heuristic and its forms predetermine for us certain modes of observation and interpretation. Thus, students learning science in a foreign language, especially in rural primary schools, cannot be expected to fully make sense of the communication patterns used by teachers. English, in this case, retarded students in their exploration of scientific experiences and was a hindrance to their learning.

What I concluded from observations in this study was that English detached students from their lived experiences. This "detachability" should be the reason why the language policy in Zimbabwe should give more significance and importance to the use of indigenous languages as co-media of instruction in schools. The use of language in primary schools in Zimbabwe pointed to a privileged status given to English over indigenous languages such as Shona. English and Shona are official languages of unequal status. Regardless of the observation that all students and teachers in the school spoke Shona, English was generally accorded a higher profile than the mother language. Although teachers code-switched between the two languages, the two were used unequally as media of instruction. The unequal use of English and an indigenous language is widespread in former British colonies. Arua and Magocha (2002) made a similar discovery in Botswana where they found out that English and Setswana were treated differently, with English having greater use than Setswana in schools. In South Africa, Chick (2002) reports that code-switching (English to Zulu) was not permitted except in such non-prestigious settings such as the playground, or where learners are viewed as "deficient" in English.

In the rural classes I visited, code switching between English and Shona, the local language, was widespread. The mother language gave the students the courage to freely express themselves, and the opportunity to freely interact with the teacher and other students. Code switching helped students to move from silence into speech, thus giving voice to the students. However, there were some teachers who seemed to discourage students from code switching, although the teachers were observed doing so themselves. Surprisingly, some teachers were totally against the idea of teaching science in the local languages as a medium of instruction. This finding was similar to that of Arua and Magocha (2002) who discovered that in Botswana, no respondent in their study indicated a preference for the use in schools of Ikalanga, a minority indigenous language. In a study carried out in South Africa, Chick (2002) also found out that administrators and teachers explicitly rejected the use of Zulu in classes.

The usual justification for using English over indigenous languages in Zimbabwe is the lack of universally accepted scientific and technical terms. The scope of Shona in the teaching of science was understood to be limited and could not help students to become global citizens. The justification for using English overlooked the difficulties of cognition and understanding that students faced, especially those in rural areas who encounter English only in the classroom. Bunyi's (1999) study in Kenya reached the conclusion that when the use of English dominated in science instruction, students could not apply what they had learned to practical situations at home. Educational policy makers, administrators and teachers should be concerned more about the practical possibilities of science at home than about its international recognition.

The silence that dominated the classrooms was a result of the dominance of English as a medium of instruction. Teachers made little attempt to make Shona a welcome language of science learning. They tended to equate the conceptual difficulties faced by rural students with cognitive inadequacies, when in practice it was more closely linked to their inability to learn concepts in a foreign language. Usually, when teachers used code switching it was for the purpose of making translations, translating an English term to a Shona word such as *thorax* (English) to *chipfuva* (Shona) or *charcoal* (English) to *marasha* (Shona). However, teachers admitted that at times it was difficult to translate some of the scientific terms to a local language. The main problem with the schooling system in Zimbabwe is that the school is regarded as the place where foreign things are taught – things that would help students pass examinations which, in turn, might enable them to move to the next level of schooling or perhaps, if they were fortunate, to secure a paid job. This perception reinforces the importance of English and the marginalisation of local languages.

POLICY IMPLICATIONS AND RECOMMENDATIONS

The recommendations articulated in this section were arrived at after observing some shortcomings and lack of adequate educational policies in the teaching of science. The primary school science curriculum in Zimbabwe does not explicitly address the role and importance of indigenous knowledge and local languages in the teaching of science. The curriculum is designed from and follows the colonial form that amplified and reified Western philosophy of science. Any changes that were made were largely cosmetic. Policy makers and curriculum planers need to realize that Africanization or indigenisation of the science curriculum is beneficial to both learners, and the community which makes use of school knowledge to advance development of society. The state, through policy makers, academics and teachers, should not disqualify some types of knowledge and valorize others by establishing a hierarchy of knowledge. The hierarchy subordinates indigenous ways of knowing, encased by the more general and abstract ("modern" Euro-centric) science, at the top (Foucault, 1980). In addition, teachers should acquire attitudes that are open to change so that they can provide spaces for indigenous science and grant voices to students to narrate their scientific experiences derived from home life. The following recommendations are based on the findings and conclusions of the case study and those of other studies reported in the literature:

Resource material for indigenising school science

Teaching and learning in schools is dependent on the availability of information. The information could be documented or collected informally. When contrasting formal learning and informal learning of science, the most glaring difference, as raised by the teachers in this study, is that of verifying the "truth" of what has been identified and defined as "scientific knowledge." Therefore, the major obstacle and barrier to the teaching of indigenous knowledge and science in primary schools in Zimbabwe is the availability of verifiable resources. Unfortunately, school science for some teachers is associated with empirical "Western" science and modes of thinking and knowing. It entails data that can be observed, and results verified through experiments. The words *experiment, apparatus, proof*, and *observation* featured prominently in most interviews. Even in lessons that I observed, every teacher made an effort to include an experiment of one kind or another in order to gather verifiable conclusions. There was an overall feeling that what hinders teachers from incorporating indigenous knowledge into the teaching of "formal science" in schools is the absence of written and documented material on the subject. Unfortunately, educational institutions in Zimbabwe, especially institutions of higher education - universities and teachers' colleges - do not have centers that specialize in indigenous knowledge, science and resources. The following recommendations are suggested to redress this situation:

1. A Centre for Indigenous Knowledge and Science (CIKS) should be established at one of the universities in Zimbabwe to assist not only teachers, but also everyone interested and involved in trying to elevate the importance of indigenous knowledge and science in schools and in sustainable community development in the country.
2. Each university and teachers' college should have a department that liaises with the CIKS to produce documents and disseminate information on indigenous knowledge and science. The departments should be involved in carrying out research on indigenous ways of learning and sense making,

and how these could be incorporated into the learning and teaching of school science. The CIKS should coordinate this research and keep a database of all projects conducted to be used as reference by anyone interested in furthering research on indigenous knowledge and science and their implications for school science.

3. To document information on the teaching of school science using indigenous perspectives or cultural perspectives, the CIKS should initiate the publication of a journal, manuals and pamphlets that focus on incorporating indigenous knowledge into the teaching of school science, or teaching across the curriculum. Indigenous knowledge should not be viewed as belonging to one school subject, but should be a feature of every subject, if knowledge is to be relevant, appropriate, and meaningful to the local people.
4. The CIKS should also be involved in training curriculum and syllabus designers so that they become conscious of the need to incorporate indigenous knowledge and indigenous ways of learning into curriculum planning and dissemination. The training would include trainers of teachers who would later pass on this information to pre-service student teachers and in-service teachers needing upgrading.
5. Involvement in indigenous knowledge and learning should not be limited to academics only. Indigenous knowledge is found among the members of the community, especially the rural community. In Zimbabwe, some universities and teachers' colleges, especially those run by churches, are located in rural areas. Therefore, academics, parents, elders within communities and teachers can become part of the larger community of people involved in promoting indigenous knowledge in science program and in other subjects in school. This can be done through forming associations that could be affiliated to the CIKS. In this way everyone who matters could have his or her voice heard and contributions valued. These associations, especially those based in rural areas, could be vital in determining and planning the direction of sustainable rural development.

Since they will be embedded within the cultural and social environment of the indigenous people, they are likely to be in a better position to understand and appreciate the developmental needs of local people. Decision making on developmental information and projects would cease to be dictated to people but would adopt a bottom-up communication mechanism that places the interests of the local communities first.

Education Policy: creating space for indigenous knowledge

School knowledge is determined by educational policies that are put in place by the government, through legislation or education acts. Sometimes legislation can promote equity in access to education, but result in unequal opportunity in the learning process when some voices are marginalized from the formal school curriculum. The 1987 Education Act in Zimbabwe stipulates that every child in Zimbabwe has the right to school education and that "no child in Zimbabwe shall be refused admission to any school on the grounds of race, tribe, colour, religion, creed, place of origin, political opinion or the social status of his parents" (Government of Zimbabwe, 1987, pp. 207-208).

Although the Act seems to provide equal access to schooling, it is silent on the equality of distribution of curriculum content that has to be taught in schools and how the content is to be taught. It is glaringly silent on indigenous knowledge and its place in educational institutions. However, its language policy promotes the use of English as the medium of instruction at the expense of indigenous languages. The value of indigenous languages is peripherized. Hence, teachers are forced to use English frequently to teach science. Due to lack of a clear and open policy on the value of indigenous knowledge and science, "Western" science still dominates primary school curriculum in Zimbabwe. Indigenous cultural explanations and understanding of science, as practiced by local people, are glaringly absent. What is needed to promote indigenous explanations of science is rethinking and revisiting the education policy so that the teaching and learning of science in primary schools becomes an inclusive experience. The following are ways to enhance education policy aimed at such a curriculum transformation:

Policy dialogue

Dialogue is essential in formulating an all-inclusive science curriculum. An inclusive curriculum incorporates the views of stakeholders who are interested in developing a science that is meaningful to their social, cultural and economic needs. Government, which enacts education policy, needs to engage in dialogue with communities, teachers' associations, curriculum developers, and colleges of education, universities and civic organizations in order to come up with a science curriculum that incorporates differences and diversity. For policy to become meaningful and for it to be put into effective practice, it should involve a dialogue between policy makers and practitioners as well as other researchers. It should involve establishing some shared purposes between researchers in universities whose role is to develop theories and those in government, state agencies, colleges of education and the schools who have the power to implement policy. Policy makers should view policy making as a process that is inclusive of other voices. It should move from a political position to a social and developmental process. Policy-makers who are abstracted from real life classroom teaching processes usually demoralize teachers; therefore, teachers should be given voice in policy planning that leads to a new science curriculum. I would recommend forms of governance in educational systems that permit innovation and creativity at all levels among teachers, institutions and local systems. A prerequisite is respect for the professional status of teachers.

Language and examination policy

The current Education Act gives the English language dominance over indigenous languages. Although it is one of the three official languages in Zimbabwe, its role as a medium of instruction, especially after Grade 3, has been given greater significance. African children are invariably brought up in a social and cultural environment in which their mother tongue is the language for their informal learning, but when they go to school they enter another education system almost completely different from the one they were accustomed to, where a foreign language is the predominant medium of communication between the teacher and students. The use of English and failure to bring adequate home and community science experiences into the classroom breaks the connection between home and school, and student and teacher. The unfamiliar language and content of science, and how it is learnt, makes students begin learning from a point of doubt and they remain in doubt. The child's cognitive equilibrium is disturbed and the deep gulf between the indigenous ways of communicating and learning and the Western-oriented system of learning tends to retard the cognitive process in terms of anticipated outcomes expected from the Western concept of science learning. What is probably required to make science learning more meaningful and a rewarding experience is the activation of indigenous languages in the teaching of science in primary schools. The following ways can be applied to the teaching of science in primary school in Zimbabwe:

- An indigenous language of the immediate community should be used alongside English in the teaching and learning of science.
- Textbooks reflecting indigenous science should be written in both an indigenous language and English.
- Preparation of a dictionary of indigenous scientific terms should be carried out. This could be done through rural participatory research

involving academic researchers, writers, teachers and members of the community.

- New testing and evaluation instruments to measure science learning should be produced. This exercise should involve curriculum planners, academics, examiners and teachers.
- Besides producing new testing and evaluation instruments at a national level, measures to empower teachers as professionals should be taken. This implies that primitive or traditional forms of testing and assessment from the central bureaucracy should be abandoned as the basis for central policy decisions. Testing and measurement should instead be left in the hands of classroom teachers who know the needs of their students and the community in which the school is located.

These suggestions may appear ambitious, but the choice of language affects content selection, integration and delivery of the curriculum throughout the primary school cycle. Language policies for education are highly charged political issues, hence the need for consultation and inclusion of all expected stakeholders in deciding the policies. Lack of consultation and participatory research can lead to suspicion and resentment of the new language policy.

Curriculum innovation: inclusive community needs:

Classroom environments and pedagogical approaches that do not value the students' individual communities and cultures can be a cause for decreased motivation and poor academic performance in science. The further children are from the "mainstream" school science and culture, the greater the difficulty they will experience in obtaining a "quality" and "equal" education. Rural students in Zimbabwe are disabled and disempowered in ways similar to how their communities are disempowered by interactions with various educational institutions that are responsible for curriculum planning and innovation.

Curriculum planning and design is not an isolated process. It is an on-going and continuous process that requires knowledge of the needs of students, communities and the nation at large. Schools must provide students from all cultures with an appropriate and equal opportunity for science education. They also have moral obligations to protect children from dominance, prejudice and violence. To impart knowledge and help foster in students an attitude of respect for cooperation with people from different cultures in the development process, the school must have a science curriculum that supports family life, presents personally meaningful subject matter, and respects local culture. To initiate a new primary school science curriculum that is inclusive and sensitive to the needs of students and their communities:

- Curriculum planners should engage in a needs assessment research program that involves various stakeholders in the country. It is through this process that they will be able to know the content, language and organisation of science knowledge that would be needed in primary schools in Zimbabwe, irrespective of the location of the school.
- Curriculum planning should also be inclusive, involving teachers' organizations, colleges of education, universities and publishing companies.
- The above groups should carry out participatory and collaborative research, to determine the science program. These groups should come together to put policy into practice by producing a science curriculum that would be appropriate and relevant to the cultural, social and developmental needs of society.
- A new transformative curriculum should include all forms of science, "Western" and "indigenous" alike, and should be taught in a language best understood by students. Traditional or folk culture should be treated as scientific knowledge, like any other school knowledge. Children do not come to school on an equal footing for scientific or academic discourse but should be allowed to participate in critical discourse using knowledge from their family history and primary socialization.

Needs assessment and participatory research are vital to diverse cultural capitals and dispositions that structure the behaviour, perceptions and representations of social reality that are to be incorporated in the teaching and learning of primary school science in Zimbabwe. If cultural sensitivity and inclusivity are the bedrock of the science knowledge in the new curriculum, then politicians, researchers, curriculum planners, and parents should work with and alongside teachers to whom they delegate the responsibility for bringing up a student who is a useful citizen to the community and the nation. Meaning making is more important than memorizing facts that cannot be put into practice. So, a science curriculum should be designed for implementation in a language of possibility that frees students from the enslaving memorization of factual science.

Teacher training for indigenous ways of knowing

Academics and teachers are usually negative to new frames of knowledge, especially if the latter involve knowledge considered "traditional" and "primitive" by Western standards. It is the hierarchical ordering of knowledge that teachers and academics should be challenged to overcome. Hierarchies give power and domination to one form of knowledge and disempower and marginalize the *Others* (Shiva, 1997). So teachers and academics in Zimbabwe should act as change agents and cultural-brokers that are open to new ways of knowing. Academic institutions should lead in the de-reification of Western scientific knowledge and initiate a new consciousness that acknowledges the importance of other types of knowledge. Change can be achieved through innovative and well-researched teacher training science curriculum. The success of any educational policy and curriculum innovation is dependent upon the quality and attitudes of the teachers who implement the educational programs. This begins with the teacher training programs that are in place. Socialisation and enculturation affect students' perception of science curriculum and the ways in which they learn. Teacher preparation must provide the understanding and skills necessary to deal with these differences. Schools are often populated by veteran teachers who are expected to work effectively in environments they were not prepared to encounter at the time they received their teacher training. The general reaction of teachers to the problem of underachievement, alienation and withdrawal has been to continue the use of traditional approaches to teaching and learning of science and to focus the "blame" for "failure" on the students, especially rural students. These teachers need to be offered assistance in examining their biases and to be schooled in multicultural science education.

A teacher-training curriculum that is remote from the social and cultural realities of difference that exist in Zimbabwe produces teachers who are not prepared for and capable of managing diversities that exist among the country's students. Such a curriculum leads to a distortion in the perceptions of students and a disfigurement of the true understanding of their scientific society. Links between teacher education, primary science education and societal needs should be established, maintained and strengthened. It appears that within colleges, the formal science curriculum and the actual practice may indeed prove to be even less relevant to the needs of schools and society because there is little research that is done by the lecturers to keep abreast of the current changes in the needs of society, and the product that society expects from schools. Teacher training colleges need to change the way they prepare teachers for teaching science. They need to transform and revitalize their curriculum and pedagogical practices.

Change in teacher attitudes can be fostered through teacher education programs that focus on conscientizing teachers to advance democratic principles in classroom practice. Through conscientization, Freire (1985: 43) says teachers should be able to have a "different understanding of [their] history and [their] role" in the classroom. Such teachers are likely to change their perceptions on classroom social order and create spaces in which students can be equal participants as *subjects* and not *objects* in the learning circle. As *subjects* students become active and critical learners and not passive learning *objects*. To limit dissent and deviance in classroom relations and nurture dialogical engagement, the teacher and students collectively determine class rules, interactive groups and modes of communication. Most importantly, 'knowledge' and 'class discipline' will cease to be the teachers' private intellectual property and authority and 'universal truth' but instead a product of historical participation and social action, publicly determined and owned affirming the mutual and coequal roles of the teacher and learners. A new teacher training curriculum should:

- Reduce the overemphasis on empirical methods of "Western" science that portrays experiments as the only way of verifying scientific knowledge.
- Incorporate both "Western" science and indigenous knowledge in order to validate all available forms of science. This way both urban and rural societies will have their science knowledge legitimated and validated.
- Accommodate both Western and indigenous ways of knowing and explaining physical, social, cultural and spiritual realities that define science. Differences and diversity should be the bedrock of the transformed science curriculum.
- Take cognizance of and relate science teaching and learning to other forms of education, informal and non-formal, within communities.
- Include scientific studies of local and national development in Zimbabwe as a major component based on a methodology which stresses the process of enquiry into development rather than merely learning about it.
- Contain elements which lead teachers to a more holistic enquiry based approach to:
    i. the students' social and cultural backgrounds,
    ii. the material and non-material cultural knowledge that students bring and use in school,
    iii. the communities in which the students live and the school is located,
    iv. teaching and learning techniques that are used in the communities in which students live,
    v. "scientific" skills that are relevant and used in the community in which the school is located.

  One means of achieving this is through projects based in college and carried out in communities.

vi. recognize and stress the importance of indigenous languages in teaching science.

A transformed teacher education science curriculum that takes the above into consideration opens the doors to multi-knowledge learning and incorporates various habiti: individual beliefs, customs, expectations, attitudes and aspirations that students get from their families and communities and bring to school. It recognizes that society socializes students into different mental and cognitive structures that they use to deal with their social, cultural and spiritual world. A science curriculum that incorporates community involvement prepares student teachers to ultimately become teachers who are cultural brokers. This is the type of teacher who will facilitate the learning of science in a meaningful way. Such a teacher is likely to help students move from their everyday culture into the culture of school science through cultural border crossing.

Staff development through in-service programs

It is not enough to change the science teacher education curricula for teachers in initial training. Practicing teachers are known to be very conservative when it comes to curriculum change. They feel threatened by innovations that are likely to upset the way they have been doing things. Links between teachers' colleges, curriculum innovation and in-servicing programs should be established to upgrade teachers so that they become competent to teach the new science curriculum. This could be done in three ways:

a) A program involving a college-based in-service program should be targeted at practicing teachers. This program could involve selecting some teachers from schools around the country for retraining in the interpretation and pedagogical practices of the new science curriculum. To avoid disrupting the smooth running of the schools, the college-based program should be conducted during holidays. The structure of the program could be a matter of consultation between the Ministry of Education, teachers' colleges and schools. The science curriculum that will be followed will be the one suggested above under curriculum innovation.

b) A decentralized in-school servicing program is the second option. This program would take place in schools where teachers who have attended college-based courses act as staff developers for other teachers. The program would help spread the ideas of the new science curriculum quickly to as many teachers as possible. The experiences and "new" knowledge that teachers who attend college-based in-service programs gain is likely to diffuse to other teachers in schools.

c) Distance teaching of the new science course could be conducted for teachers to complement the in-servicing programs. Distance teaching has the advantage of reaching the majority of teachers. Distance teaching techniques involving various combinations of correspondence, radio and linked residential courses could be designed and implemented on a large scale. The residential courses could be taken at various centers around the country, with centers attached to the 13 teachers' colleges scattered all over the 10 provinces.

Parental involvement and empowerment through science

A key element in many of the most recent educational reform movements in the West and also in Africa has been to increase parental involvement in the education of their children. The home and the community environment are significant contributors to student success in the learning of science and in developing positive attitudes towards science. The home functions as the most salient starting point for the out-of-school learning experience for science. Out-of-school science experiences amplify or diminish the school's effect on the learning of formal school science. A planned program for parental involvement is essential if all schools are to succeed in indigenising and Africanizing science in primary schools in Zimbabwe. Teachers should preplan schedules that show when and how parents will be invited to their classes. But as the head of the school where I conducted my case study pointed out, parental involvement in schools lacks an overall organization that allows teachers to plan and develop principled programs for parents. In traditional society parents always had the social and cultural responsibility in the informal education of their children. However, the advent of formal schooling rendered parents "irrelevant" and made them gradually more reliant on the school's judgment of their children's personalities, abilities and intellectual potential. Parents need to be re-empowered in order to regain interest in the learning of their children. Bloom (1992), cited in Shepard and Harold (1995), suggests that parental empowerment should consist of involvement, participation and advocacy. Since not all parents can freely walk into the school's gates and classroom doors without invitation to contribute towards their children's learning, groups and agencies that represent parents should be consulted when identifying members of the community who possess the knowledge sought by teachers. Organisations such as the Zimbabwe Traditional Healers Association and the Zimbabwe National Arts Council should be consulted when the need arises. Groups and agencies that represent parents can influence and monitor changes in science curriculum at the local, district and national level.

Advocacy is enhanced through participation in local, district and national groups and agencies, which impact the policy, procedures and various institutional changes affecting communities. Therefore, it is vital to put in place programs that encourage parents to take active roles in local, district and national agencies. Active participation will enable them to be involved in the setting of policies regarding the teaching and learning of science from indigenous perspectives and to influence decision making in their schools. Parental empowerment in their children's school lives is crucial for academic performance and outcomes. Because of their poverty and lack of power within the larger social structure, rural families tend to be marginalized from educational policy making decisions and curriculum issues. The negative attitudes and biases that policy makers, curriculum planners and educationists hold toward rural families perpetuate among the latter silence and conformity rather than autonomy, voice and self-confidence when it comes to decisions concerning their children's school lives. Rural schools do not do much to encourage parents to be involved in curriculum matters; these are the concerns of the professionals. As the head teacher of the school where I carried out my case study noted, his school had not done much to invite parents to be part of the curriculum implementing team. Parental involvement is therefore largely limited to non-academic areas.

Summary of conclusions and recommendations

Politicians, parents, educationists and other stakeholders should cooperate to shape these suggestions and recommendations into policy. Often policy makers in Africa do not take studies conducted by students seriously and tend to ignore research findings and recommendations submitted to them. Unfortunately, the problems affecting primary school students in learning science will not go away unless effort is taken to rectify the imbalance that exists between "Western" science and "indigenous" knowledge in the school science curriculum. Change can be achieved if policy makers consider seriously documents presented to them by independent researchers whose work is not commissioned by government.

CONCLUDING REMARKS

Questions regarding indigenous knowledge and the formal science curriculum in primary schools should be of increasing importance and concern to education planners, policy makers, curriculum developers, teacher educators and teachers in Zimbabwe and in other nations where indigenous people possess a body of non-Western knowledge and values. If Zimbabweans are serious about making their indigenous knowledge present in schools, then there is need to conduct a cultural analysis, examining our cultures – languages, environments, technologies, knowledge, skills, beliefs and values – in order to make better judgments about what should be transmitted to the next generation. To succeed in incorporating indigenous knowledge and modes of thinking into the teaching and learning of science in primary schools, a multicultural discourse should be carried on at all levels of curriculum planning and implementation. A multicultural science curriculum will provide a means for teachers, administrators, and students to create a more inclusive learning environment. Learners have agency and social identities that are often co-constructed and negotiated. Similarly science learning should be a negotiated experience since it exists and operates in multicultural environments.

Countless numbers of young people, in Zimbabwe and all over the world, are being denied the traditional knowledge and wisdom of their elders, because of linguistic separation. There is an urgent need for continued research not only into *what* cultural knowledge and skills should be included in the primary science curriculum in Zimbabwe, but also into culturally sensitive ways of teaching science. Ironically, in Zimbabwe, parents, politicians, educationists, teachers and other professionals pay lip service to the importance of indigenous knowledge and science, especially when it comes to the education of our young, including our own children. Many Zimbabweans, including those who make decisions about future directions of formal education, hold to Euro-centric ideological assumptions associated with the English-only discourse. They continue to send their children to private schools, which teach exclusively in English, because of deep-seated assumptions that English is superior to local languages. Perhaps research is therefore needed to determine the social and cultural impact of private schooling on students in comparison to those students who learn in rural schools.

There is, of course, the argument that because Zimbabwean students need to have access to Western cultural capital in order to compete in a world dominated by Western ideas, it is necessary to teach science using Western perspectives if students are to compete more effectively in an increasingly competitive globalized world. My recommendations, however, do not imply that teachers cease from teaching about other cultures and their ways. Indeed, we have adopted and adapted foreign ways and made them our own. But what is being advocated is a conscious effort to look more closely at indigenous cultures for new insights into and solutions for some of the educational and developmental problems Africa is facing. What is important in our education system is to develop indigenous perspectives in understanding various socio-cultural and psychological phenomena. Education policy makers and teacher educators should be aware of the current shortcomings in the primary science curriculum and find ways of overcoming them to make education policy and teacher training characteristically multicultural. Teachers are hesitant and unsure of the importance and place of cultural knowledge in the current global knowledge boom. They are confused about the role that indigenous knowledge and indigenous perspectives should play in teaching science. In fact, they are not familiar with ways in which indigenous knowledge could be relevant to the teaching and learning of science. Hence, most feel that Western science should be the science for schools. It is because the terms "traditional" and "backward" tend to be given to anything *indigenous* that teachers are confused.

Finally, as Bruckerhoff (1995) argues, determining *whose* knowledge is of greatest worth should not be a political matter to be settled by governments or experts only. This is a top-down undemocratic approach to education policy rather than an inclusive bottom-up approach. These outsiders, precisely because they come from outside the local community, would promote a science curriculum that is imposed from the most assertive political ideology. Instead, democratic educational policy that empowers teachers, students and the local people to determine their community developmental pathways ought to support a core of indigenous knowledge appropriate to the local culture. The essence of this science curriculum must be based on inclusion and multiculturalism. It should incorporate indigenous knowledge and languages in its pedagogical approaches and be respectful and relevant to the local culture and needs of local communities for sustainable development.

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Appendix IX

Teacher Interview Schedule

These questions are a guideline for the interview so that the conversation does not lose the focus of the study. More questions will arise from the classroom observations that will have been conducted earlier.

1. How long have you been a science teacher?
2. Tell me about the "science" that you teach to your class. Why do you consider this to be "science?" Is there any other form of "science" besides the one you have described to me?
3. What do you enjoy most in teaching science to your class? Tell me about a memorable lesson that you have ever taught (exciting or boring lesson). What makes you remember that lesson?
4. How do you make sure that your students follow what you are teaching them? Tell me about the teaching strategies/methods that you use in your science lessons.
5. Where do you get the information/knowledge of science that you teach your class? Are there any other sources that can be used besides those you have mentioned?
6. What difficulties do you experience when teaching science? How do you usually overcome them?
7. Some students may experience problems in understanding and following the topic or concepts that you will be teaching. How do you help these students to make sense of what they are supposed to learn?
8. Some people say that science is what is taught and learnt in schools only. What do you say to this?

9. Can you remember any time when you had to teach something that was not in your science textbook? What made you do that? How did your students respond to it?
10. Do you ever invite other people to help you teach a topic or concept of science that you may not be sure of? Whom have you invited before and why that/those particular person(s)?
11. How do you incorporate, in your teaching of science, the knowledge that your students bring from home? How do you find this knowledge helping you in your teaching?
12. Is indigenous/local knowledge as important as the science that is largely portrayed in the school syllabi and textbooks? What should be done to make you competent in incorporating indigenous/local knowledge in your teaching of science?